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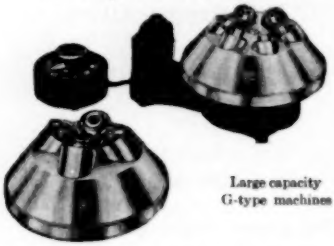

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THE QUARTERLY REVIEW
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NEOPLASTIC GROWTH IN PLANTS

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INTRODUCTION

SOME time ago it was suggested that the time might now be ripe for a review of our knowledge of "abnormal growth in plants." Such a subject is at once so vast and so ill-defined that an adequate treatment would, I am sure, be far too voluminous to be encompassed in the pages of a journal article. It has seemed best to restrict the present treatment to a much narrower field, namely, to what may be termed "neoplasia" in flowering plants. The types of neoplasia of greatest interest are, of course, those which are non-limited in character. Limited neoplasia will be considered only in so far as they may appear to contribute to our understanding of non-limited neoplasms.

Limited neoplasms are those in which the morphogenetic character of the tissues involved does not depart widely from that of the normal plant (a condition which is difficult to define precisely), and in which the aberrant growth does not proceed beyond strict limits in space and time set by the nature of the normal plant. These limits, being quantitative, are more easily defined than the more qualitative morphogenetic qualities. Chimaeras (Winkler, 1912; Jones, 1940), fasciations (White, O. E., 1945), and cecidological galls (Houard, 1908; Küster, 1911) are typical examples of *limited* neoplasms. Especially in the last, the cecidological galls, the limits of development are defined with remarkable exactitude. *Non-limited* neoplasms, on the other hand, are those in which the degree of morphogenetic aberration and the extent of growth are not controlled by the nature of the affected plant but only by the exciting factor or factors. Bacterial crown-galls (Smith, 1920) and the hereditary tumors of *Nicotiana* (Kostoff, 1930) [see below] are non-limited neoplasms.

Besides the classification set forth above, which is qualitative in nature, it is desirable, on an etiological basis, to separate neoplasms into those which are internally conditioned (spontaneous) and those which are externally conditioned (induced).

Most naturally occurring neoplasms of animals are presumed to be internally conditioned (Ewing, 1940). There exists, however, a whole series of exceptions, such as the virus tumors: Shope papilloma (Shope, 1933) and Brown-Pearce tumor of rabbits (Brown and Pearce, 1923); Rous sarcoma of fowl (Rous, 1912); the Bittner mammary tumor of mice (Bittner, 1940); the *cysticercus* tumors of rats (Febiger, 1913), etc. The whole range of tumors induced by carcinogens is likewise externally conditioned. The line of demarcation is not very sharp, for the Shope papilloma, which is ordinarily benign, may be rendered malignant by suitable combination with agents which are themselves only mildly or tardily carcinogenic (Rous and Kidd, 1938). It seems highly probable that a great many tumors which are now classified as "spontaneous" will eventually be transferred to the "induced" category as more information is accumulated. This probability is strengthened by analogy with the state of affairs as regards plant neoplasms. In plants, neoplasms which are still classified as

spontaneous are rare indeed. They are restricted to the relatively mild and clearly delimited chimaeras, many of which are due to somatic chromosomal mutations, to the benign fasciations, some of which are probably genetic in origin and a few of which can already be assigned to a virus origin, and to the much more dramatic tumors which result from hybrid incompatibilities, as in the case of the well-known *Nicotiana glauca* × *N. langsdorffii* cross. Whether one can class neoplasms known to be chromosomal in origin as truly "spontaneous" is perhaps a question of semantics. At least, no "external" agent is involved.

There is, however, in plants an enormous variety of recognizably induced neoplasms. These are limited in development, but nevertheless exhibit many characteristics which serve as a basis for comparison with the non-limited neoplasms.

LIMITED NEOPLASMS

Neoplasms of non-biological origin

Physical galls. The callusing which occurs at the margins of any wound, while it may have a physical agent as its initial cause, nevertheless has as its more proximate cause a combination of derangements of water economy and respiratory rate, an accumulation of products of necrosis, etc., all of which are essentially chemical in nature. There are, however, a number of overgrowths in which these chemical factors play at most a minor role, and which have a more clearly defined and permanent physical basis. In horticultural practice it has long been known that if a scion is inverted in grafting, either accidentally or intentionally, there will frequently result a massive overgrowth at the point of union (Vöchting, 1892). This overgrowth will generally not occur if stock and scion are joined in normal order. The cause is therefore not one of tissue incompatibilities of a chemical nature, nor of necrotic products. The only possible chemical cause would seem to be a matter of polar distribution of particular products. Vöchting (1918) showed that this overgrowth results from the tendency of the individual cells of both stock and scion to maintain a definite polarity. Cells behave like magnets, and, just as the like poles of magnets repel one another, so the physiologically like poles of cells show a similar repulsion, their distal ends tending to avoid the distal ends of adjacent cells and to approach proximal ends. Since plant cells are not capable of motion to correct any unsuitable orientation, such a correction can only take place by growth. As each new cell is formed, it tends to orient its axes in accordance with the "lines of force" set up between stock and scion. (This is merely an analogy, since true electromagnetic forces have not been demonstrated here.) The result is at first a random arrangement of cells, an intumescence. Only when the cells in the entire outer portion have been reoriented so that all have parallel and similarly polarized axes does the tissue settle down to a stable pattern which permits a normal type of morphology. This reorientation is only rarely achieved, and an intumescence usually results. The polarity of cells thus may be of considerable importance as a factor in the etiology of tumors.

While the above description is not intended to demonstrate either electromagnetic or electropotential polarities, these do exist, and they may or may not be causally related to the production of neoplasms. In studying the electropotentials of plants, first Waller (1900) and later Lund (1928, 1946) and his students showed that growing regions—stem and root tips, buds, tubers, etc.—are regularly electronegative to the more mature or more physiologically quiescent regions. This potential can be reversed by altering the oxidation-reduction gradient; that is, if a root tip is fed a hydrogen atmosphere in place of its normal high-oxygen atmosphere, it becomes electropositive and ceases to grow terminally (Marsh, 1928). The region of growth is, however, not destroyed but only displaced, so that branch roots tend to emerge at some point back of the tip. This change in electropotential and growth pattern imposed by the oxidation-reduction pattern is reversible. Moreover, if an inverse electropotential is artificially imposed by means of suitable electrodes instead of by modifications in the gaseous environment, a similar shift in growth pattern results, the branch roots emerging at the point where the electropotential becomes negative to both distal and proximal regions (Berry, Gardiner, and Gilmartin, 1947). In some plants, this point of potential reversal is the site of formation of a well-defined small tumor instead of root primordia. These facts will be reexamined later.

Chemical galls. The overgrowths just described are initiated by purely physical factors, although it would be folly to assume that their development is not subsequently mediated by chemical ones. The line between these two groups is not a sharp one. There are, however, many intumescences whose initial as well as proximal causes are chem-

ical. It has long been known that many sprays, even salt water, will cause intumescences (galls) on the leaves and stems of certain plants (von Schrenk, 1905). Indeed, water alone, when present for some time as discrete and more or less fixed droplets (dew drops) will cause localized overgrowths on such plants as cabbage and tomato. So will a saturated atmosphere in somewhat less regular fashion (La Rue, 1933; Gäumann, 1939). In some cases this is probably no more than an osmotic response (hyperhydric enlargement) (Küster, 1937). In others, however, it is an active response to solute ions or ion combinations. Copper salts, for example, tend to induce such growths (von Schrenk, 1905). The organic acids (malic, acetic, formic, butyric, lactic, etc.) are particularly active tumefacient agents (Auler, 1925; Blumenthal and Meyer, 1924). Smith concluded that acetic acid and its salts were important factors in the etiology of "crown-gall" (Smith, Brown, and Townsend, 1911). This conclusion appears to have been an extraordinary anticipation of the facts as regards the function of indoleacetic acid, to be discussed at length later, since it antedated by more than 20 years the discovery of the growth-stimulating activity of this substance (Dolk and Thimann, 1932). Formic acid has been considered a factor in the production of insect galls, and a similar role was ascribed as early as 1675 to insect secretions by Malpighi (1679). Following Smith's suggestion, Blumenthal and Meyer (1924), and Auler (1925) investigated at length the tumefacient properties of acetic and formic acids. Further, Haberlandt's "Wundhormone" (1921–1922) appears to involve acid products of tissue breakdown. The auxins: indoleacetic, indolebutyric, naphthaleneacetic and related acids, all have clearcut cecidogenous properties and may be responsible in part for the production of insect and other types of galls (Brown and Gardner, 1936; Friedmann and Francis, 1942; Kulescha, 1947a, b). Nevertheless, the intumescences produced by all these chemical agents are, with two possible exceptions, strictly limited and exogenous in character, continuing to develop only so long as an external source of the particular chemical involved is available. We will return to these two exceptions later.

Neoplasms of biological origin

Virus galls. Without implying any conclusion as to the living or non-living character of viruses, it seems best to consider the viruses as gall-forming agents at this point. Tissue distortions, of course, accompany any diseased or traumatized state. Some viruses produce definite patterns of tissue distortion. The "enations" induced by certain strains of tobacco mosaic virus are well known examples (Jensen, 1933). Black (1946, 1947, 1948) has recently described a still more clearly defined example which appears to be unique in that a definite tumor is formed as a result of a virus infection. This virus has a wide and varied host range and may or may not produce other symptoms than tumors, depending on the host and upon ecological conditions. In susceptible hosts it becomes systemic, but produces galls only at those points where local tissue proliferation is initiated by a wound. Thus, neither virus nor wound alone will produce a tumor, but when a cell or group of cells which has been invaded by the virus is subjected to a traumatic stimulus it is incited to rapid and disorganized growth. Superficially these overgrowths appear to be non-limited in character, but since affected cells carry a chronic infection it is not possible to determine how they would behave in its absence.

Bacteriological galls. Galls of bacterial origin occur on a great variety of hosts (Smith, 1920). In the case of the bacterial nodules of legumes, alder, *Eleagnus*, etc., they are beneficial to the host, or at least benign. Those on olive (*Phytomonas savastanoi*), on raspberry (*P. rubi*), and on Douglas fir (*P. pseudotsugae*) are injurious and highly specific. Crown gall, caused by *P. tumefaciens*, on the other hand is relatively non-specific as to host range, occurring on a great variety of plants (Smith, Brown, and Townsend, 1911). It is also relatively non-specific in its histological characteristics. Within the gall itself there is a high degree of histological derangement, with hyperplasia and hypoplasia, rapid and well-organized cambial growth and necrosis, all occurring within relatively closely associated regions of a single cell mass. In most cases it has been supposed that growth of these masses was strictly dependent on the presence of the living invader and in this respect differed in no wise from irritation teratomas in general. We will see later, however, that this assumption is not always justified.

Mycological galls. Galls caused by the presence of fungi (including the Myxomycetes) are too varied and numerous to permit more than brief mention. The "club-root" of cabbage is the classic example (Woronin, 1878). Here abnormal proliferation is limited to the tissues actually invaded

by the infecting organism, or to those adjacent tissues placed under abnormal conditions of pressure and tension by the presence of invaded and hypertrophied masses. There is no evidence that these overgrowths ever become independent or non-limited. They are simply traumatic responses. Many "burls" probably have this sort of origin.

Phanerogamic galls. There are a few galls which are caused by the presence of phanerogamic parasites. Mistletoe is perhaps the most widely known example of such a parasite, but the root galls caused on the roots of many plants by parasitism with *Comandra* and other members of the Santalaceae, or on those of the beech tree by the "Beechdrop" (*Epifagus*) are of similar nature. In most cases the tissue response of the host is not marked and the galls are of minor importance.

Neoplasms of animal origin. Galls of major importance are produced in flowering plants by members of only two animal phyla, the Nemathelminthes and the Arthropoda. Protozoa and other organisms are known to produce galls occasionally, but these are of little importance.

Nemathelminthic galls occur on the roots, stems, leaves, and reproductive parts of many different species of plants. Attacks do not, as a rule, bring about massive tissue proliferation, and the galls are of little importance as examples of neoplasia. Their chief interest, aside from economic considerations, lies in their homology with the cysticercus tumors which occur in animals and which are known to become malignant (Febiger, 1913). Nematode galls on plants are, so far as is now known, strictly dependent and limited in development.

Of much greater interest and potential usefulness are the insect galls, the study of which makes up a large part of the science of cecidology. Houard (1908) lists 1252 species of insects causing galls and 6075 recognizable distinct sorts of galls to be found on the angiosperms of Europe alone! There are over 900 distinct sorts of galls on the Fagaceae alone, mostly on oaks. These are of great variety of form and degree of anatomical complexity, and of such extraordinary specificity that the males and females of certain insects will induce recognizably distinct galls on a given species of host. Yet all of these galls are, so far as is known, strictly limited in character, developing only so long as the invader or its immediate products are present. This limited character reaches perhaps its extreme in the case of certain sac-like galls induced on the fresh-water alga, *Vaucheria*, by a rotifer, *Notommata*, growths which might be called "intermittent galls" since the rotifer may leave its protective gall from time to time and return, the gall developing during the rotifer's visits but remaining static or even regressing somewhat in its absence (Rothert, 1896).

It is, of course, possible that the limited character of the growth of these galls may be the result of nutritional or structural barriers rather than of intracellular physiological barriers. If so, the tissues should grow in tissue culture, where structural and nutritional barriers are removed, in a manner different from that shown by normal, non-gall tissues. To test this possibility, aseptic tissue fragments have been isolated from certain of the relatively solid galls on *Solidago*, as well as the more complex hairy or spongy galls on *Quercus* and *Rubus* (White, unpublished), and have been placed on a nutrient found to be suitable for growth of various plant tumor tissues (see below). So far, however, these experiments have consistently failed. The gall tissues as well as normal tissues have undergone rapid differentiation of cork and later lignification, and quickly become quiescent. No permanent cultures have been established from these tissues. Although so far disappointing, these experiments need to be greatly extended, particularly in the light of the recent work of Morel (1944, 1945a, b, 1946a, b, c, d, 1947) and Gautheret (1942, 1948b) on the nutritional requirements of other woody species. Attempts to verify Malpighi's theory that galls arise as a result of injection of a poisonous fluid into the host tissues by the insect parasite, by isolating a gall-inducing substance other than heteroauxin either from insects or from the galls themselves, have likewise consistently failed. The only promising result has been that of Beck (1946), who found that trypsin may cause limited overgrowths when injected into plants. This, however, can hardly be considered a specific cecidogenic agent, since the effective agent might be any of innumerable tryptic digestion products of the host proteins themselves. Formic acid is, of course, a common product of insect metabolism. It is a mild tumefacient agent. But so are acetic and malic acids. Smith believed that acetic acid and its salts were factors in the production of crown-galls (bacterial) (Smith, 1917; Smith, Brown, and Townsend, 1911), and Blumenthal and Meyer (1924) and Auler (1925) made extensive investigations on the tumefacient properties of the organic acids. In all cases, the

tumors were strictly limited and dependent. These studies on cecidology, particularly that associated with insect galls, have added surprisingly little to our understanding of tumor etiology, in spite of their very great theoretical promise. Von Goebel, in his *Organographie der Pflanzen* says, "The answer to this question (of the nature of the stimulus causing galls) I consider of more importance for morphology (as defined by Goethe) than is the pursuit after apical cells and other questions of detail upon which so much time has been expended" (p. 199). In spite of the vast amount of effort expended upon these studies, with so little result, they certainly deserve still more intensive investigation.

NON-LIMITED NEOPLASMS

All of the overgrowths mentioned so far have this in common, that they are strictly exogenous in origin, arising as a result of the presence of a foreign body of one sort or another and continuing to develop only so long as that body or its immediate products are present in the host tissue. They are, so far as we can see, "irritation teratomas" according to Ewing's terminology (1940). They are limited neoplasms. Although similarities between these growths and malignant neoplasms of animals have been pointed out many times (Smith, 1912; Nobécourt, 1937b; Nobécourt and Dusseau, 1938), these similarities have never been generally accepted as being more than fortuitous. The reason is, of course, just this fact, that the neoplastic growths in plants have generally been traceable to recognizable and persistent external stimuli, while cancer in man and animals is by definition of unknown origin. The recognition of virus tumors and tumors of chemical origin in animals has somewhat weakened this objection, but has not removed it (Rous and Beard, 1934). There exist, however, certain tumors of plants which are truly independent, at least in their final stages. What has been said so far is intended to serve only as a background against which to discuss these cases which, in the writer's opinion, represent a real, not a spurious, analogy to cancer.

As early as 1912, Smith and his associates noted that when plants of the Paris daisy (*Chrysanthemum frutescens*) were inoculated with crown gall bacteria (*Phytomonas tumefaciens*) there developed two types of tumors (Smith, Brown, and McCulloch, 1912). One, at the site of inoculation, was generally massive and irregular, often partly necrotic, and generally, but not always, yielded a profuse growth of the inciting organism when plated onto nutrient agar. The other type was generally smaller, smooth or only slightly irregular, seldom necrotic, and often yielded no bacteria. These "secondary" tumors arose at a distance from the site of inoculation, often three or four internodes away. They arose at the leaf axils or on the midribs or petioles of the leaves, seldom on the stem proper, and were not connected to the primary tumor by any continuous recognizable tumor tissue. They did not arise in the stem tissues immediately adjacent to the primary tumors, hence were evidently not the result of *direct* diffusion of metabolic products, either of bacteria or of tumor tissues. The apparent sterility of these tumors did not correspond at all to the current concept that all plant tumors were "irritation teratomas." Smith (1925), in fact, believed that animal and human tumors were also of biotic origin, and as a result refused to accept his own evidence of the sterility of these secondary growths on the Paris daisy. The obvious conclusion, that here was a growth which had become truly independent, was ignored.

At about the same time Jensen (1910), the father of modern experimental cancer research and best known for his demonstration of the transplantability (artificial metastasis) of animal tumors (Jensen's sarcoma of rats), described certain tumors on sugar beets. Although they were presumably originally of bacterial origin, he, like Smith, found them to be bacteria-free. He showed these growths to be transplantable in series, and by grafting into beets of different color (red beet into yellow and vice versa) he demonstrated that there was no deep invasion of host tissue by tumor tissue. Nor was there any evidence of transmission of an infective agent, either bacterial or virus, since tumors developed only from cells of the implant, never from contiguous host cells. Jensen considered the analogy between these growths and his rat sarcoma to be a real and significant one. He said in part:

> "I believe that I may say that, in the crown gall, we are dealing not only with a true neoplasm but with a tumor which possesses certain similarities with the malignant tumors of animals; in fact I am inclined to believe that it will play a role in cancer research similar to that now played by the mouse carcinoma." (Jensen 1910. Translation, P. R. W.)

Unfortunately, Jensen was a generation before his time, and his detailed paper was published in the Danish language in an obscure veterinary journal (Jensen, 1918). Except for Erwin Smith's interest and praise this work was largely ignored. It was not until a quarter century later that this particular aspect of tumor etiology was reopened by Braun and White.

In 1941 Braun, working with sunflowers, rediscovered the secondary galls reported by Smith, Brown, and Townsend in 1911 as occurring on the Paris daisy. Again Braun found the galls to be apparently sterile and to have no evident anatomical continuity with the primary galls. Moreover, he found that when sunflower plants were inoculated with attenuated strains of crown gall bacteria which produced no *primary* galls, nevertheless secondary galls were produced at a distance from the site of inoculation. The secondaries thus appeared to have a different physiological origin from the primaries, and to depend for their inception not exclusively on properties of the bacteria themselves but also on host characteristics. If these growths were really free of bacteria they would then represent true independent neoplasms, something new in plant science and, as Jensen had recognized, of great importance. Braun exhausted the usual bacteriological proofs of sterility and added to them serological tests which, while of great importance in animal studies, are of somewhat less reliability in dealing with plants (Braun and White, 1943). These were, however, not sufficient and a new technique, that of tissue culture, recently perfected by White in America and by Gautheret and Nobécourt in France, was brought to bear on the question. This approach has proved to be of very far-reaching importance (White and Braun, 1942, 1943; White, 1948, 1949).

It was known from White's earlier work that if the nutrient developed for cultivation of root tips was modified by addition of agar only, and tissues from the meristematic regions of plants were isolated thereon, tissues of normal plants would rapidly form wound cork, would enlarge slightly, but would quickly become lignified and quiescent (White, 1939). This nutrient produced a limited differentiation but very little proliferation. Permanent cultures could not be established on it. Tissues of the hereditarily tumorogenic hybrid, *Nicotiana glauca* × *N. langsdorffii*, on the other hand, grew actively on this same nutrient with very little differentiation, and could be established as permanent culture strains. The crown gall bacterium likewise grew very well on this nutrient, so well, in fact, that any tissue carrying such bacteria would very quickly be smothered by their growth. White and Braun reasoned that cultivation of tissues from sterile secondary galls on this medium would furnish answers to two important questions. First, if crown gall bacteria were present in the tissues, maintenance on this medium for long periods (a year or more) should certainly demonstrate their presence if the tissues grew at all actively. Second, growth of the tissues themselves on such a medium would be indicative, though by no means proof, of tumor characteristics. Since tissues so isolated grew rapidly and without diminution in growth rate for periods up to eight years, and since bacteria did not appear in these cultures at any time after primary sterility was once established (as it was in about 90% of the isolations studied carefully) (Braun and White, 1948), the characteristic independence of these growths was fully established (White and Braun, 1942). Their tumor character was further shown by Jensen's original method, grafting bits of the tissue cultures into healthy plants where they produced typical tumors (White and Braun, 1942; White, 1944, 1945). Healthy tissues grafted in the same way produced no tumors. Cultures were successfully grafted from sunflower tissues into artichoke (*Helianthus tuberosa*), and new strains of sterile tissue cultures were reisolated from such graft tumors on both *H. annuus* and *H. tuberosa*. It was thus demonstrated, according to Koch's postulates, that the cause of the "disease" was the tumor cell itself and not any accompanying organism. That these cells have become endowed with the qualities of disorganized growth both in vitro and in vivo, and with the capacity for artificial metastasis (transplantability), is now unquestioned. That they in some way owe this change to the interaction between host cells and the initial infection is also clear, although the manner in which this change comes about is still obscure.

De Ropp (1947c) has pushed this one step further by demonstrating that the inner tissues of primary galls on compositaceous plants are also frequently sterile (as Smith had found 35 years before) so that bacteria-free tissue cultures can be isolated from them.

It is clear, therefore, that crown gall tumors, at least in the Compositae, are not strictly and permanently dependent, but may become autonomous.

These demonstrations of the existence and easy availability of independent, autonomous plant tumor tissues has opened up a wide and hitherto unavailable field for investigation into the etiology of tumorigenesis. Studies in this field during the past decade can be divided conveniently into three groups: those dealing with intact tumors in situ, those dealing with tumor tissues in vitro, and those dealing, either in situ or in vitro, with normal plant tissues subjected to treatments which might conceivably serve to confer on them the properties of independence which characterize tumor tissues.

Plant tumors in situ. These studies have been largely under the leadership of Dr. Armin C. Braun at the Rockefeller Institute at Princeton (now in New York). Plants inoculated with crown gall frequently show a number of secondary responses (Locke, Riker, and Duggar, 1938). These include responses such as epinasty (de Ropp, 1947b) and the production of excessive numbers of adventitious roots (Brown, 1929). These responses are characteristic of particular strains of bacteria, and they are entirely wanting in strains of attenuated bacteria which produce no primary tumors (Braun, 1941). Yet these attenuated strains, which give rise neither to primary tumors nor to epinastic and rooting responses, do give rise to secondary tumors. Secondary tumors regularly occur on the midribs and petioles of leaves and in their axils, but seldom occur on the woody stems, even in close proximity to the primary tumors. It appears therefore that secondaries derived from such attenuated bacteria are the result of interaction between products which move upward from the site of inoculation, that is, either from metabolizing bacteria or from the tissues immediately invaded by these bacteria, products which do not of themselves alone produce tumors, but interact with some host product which is present at critical concentration in leaf tissues yet not always present in stem tissues. Leaves are known to produce auxins of the indoleacetic acid type which move abaxially and are gradually dissipated in the stem proper (Avery, 1935). Such products are also known to be produced by many bacteria, including *Phytomonas tumefaciens*, but it is not known if there is a difference in this respect between virulent and attenuated strains.

The occurrence of secondary tumors on the leaf petioles and axils and the absence of primaries, together with the absence of epinasty and rooting response, suggested that the production of secondaries might result from the interaction of auxins originating in the leaf with some unknown but possibly auxin-like product of the bacteria. It further appeared that the capacity to produce these supposed bacterial auxins in tumefacient quantities might be lost in the process of attenuation, in which case primary tumors might be induced by combining the effects of attenuated bacteria with a simultaneous application of growth substances. This possibility had been tested without conclusive results by Riker and others (Riker, 1942). It was brilliantly verified by Braun and Laskaris (1942). Massive tumors were produced on tomato plants by needle prick inoculation with an attenuated strain of bacteria a centimeter back of a cut surface and simultaneous smearing of the cut surface with a lanolin paste containing indoleacetic or naphthalene-acetic acids. Neither treatment alone was able to produce significant overgrowths. Bacteria, when reisolated from these tumors and inoculated into new hosts, produced no tumors, showing that the effect produced had been on the host cells, not on the bacteria. Moreover, many of these tumors proved to be bacteria-free, and they could be reproduced by transplantation of tumor tissue. Unfortunately, Braun and Laskaris did not isolate permanent strains of tissue cultures from these tumors. Hence, the sterility of the particular fragments transplanted was not conclusively established, and the graft tumors *might* have come from bacteria present in the transplants. Since, however, the bacteria alone would not produce tumors, it is clear that the host cells had undergone some permanent change rendering them at least co-tumorigenic if not completely independent. This whole study deserves to be elaborated.

Quite a different approach to the analysis of the process of tumefaction was likewise initiated by work of Riker and his coworkers, and brought to fruition by Braun. It had long been known that hot weather was unfavorable for the development of typical galls (Riker, Henry, and Duggar, 1941). Riker had shown that the bacteria were killed in vitro at a temperature of 40° C. Many plants survive long periods at this temperature (104° F.) in nature, but when the technique of fever therapy was applied under laboratory conditions the hosts generally did not survive temperatures sufficient to kill the bacteria. Braun found, however, that the semitropical apocynaceous plant, *Vinca rosea*, could be kept at a temperature of 45° C. (113° F.)

for as much as 5 days and that this was sufficient to destroy all bacteria in its tissues (Braun, 1943, 1947). An infection could thus be established and then destroyed at will. The plant was "cured" of its infection. Nevertheless tumors did develop, showing that, in this plant as well as in the Compositae, tumor development may become independent of the original inciting organism. There followed a series of important investigations. Braun showed first that the critical period comprises the first 72 hours after inoculation. It was then noted that, since no tumors developed at 35°, complete sterilization is not necessary, and the period of inception could be delimited by the use of 35° instead of the sterilizing temperature of 45°. This permitted the use of plants other than *Vinca rosea*. Braun and Mandle (1948) showed that bacteria could be established at 35° without inducing tumefaction and that tumefaction required a temperature of 25° or less. This period at 25°, if arranged to occupy the period between 24 hours and 34 hours after inoculation, that is, only 10 hours elapsed time, is sufficient to bring to completion the irreversible change from normal cell to tumor cell. It was further shown that the process is cumulative, since if periods at 25° were alternated with periods at 35° (following an initial 24 hour incubation period at 25°) tumefaction was induced whenever the total exposure at 25° exceeded the total exposure at 35° by at least 10 hours, and also provided that these periods did not extend beyond 5 days after inoculation. The process did not proceed beyond this 5-day period, being apparently dependent on the state of unconsolidated trauma of host cells incident to inoculation. Braun and Mandle concluded that the tumor inception is dependent on one or more enzymatic processes which are thermolabile and are reversed at 35°. The nature of these processes was not established. Further studies on this phase of the problem will be awaited with great interest.

Tumor tissues in vitro. The possibility of growing plant tumor tissues in vitro was demonstrated by White and Braun in 1941 and the malignant character of tissues so grown was established then and in later studies. Hildebrand, Riker, and Duggar (1945, 1946a, b) have elucidated many of the nutritional characteristics of these tissues. Most of the studies which bear directly on the question of the etiology of tumefaction, however, have come from de Ropp (1947a, b, 1948a, b) at the New York Botanical Gardens and from Camus and Gautheret (1948a, b, c, d, e) at the Sorbonne. De Ropp (1947a) made a careful study of the reactions of various types of tissues to the growth substances. White (1939) had shown in a tentative way that normal plant tissues do not grow satisfactorily on a simple nutrient suitable for root growth, while tumor tissues do. Gautheret (1939) and Nobécourt (1938, 1939) showed that normal tissues of carrot will grow on a similar nutrient fortified with indoleacetic acid or its equivalent. De Ropp placed both normal and tumor tissues (*Nicotiana* tumors [hereditary], *Helianthus* secondaries and sterile primaries [crown gall], *Vinca* [crown gall rendered sterile by fever therapy]) on a graded series of concentrations and sorts of auxins. Normal tissues responded, as Gautheret (1942) had shown, by a rapid growth at low concentrations, rooting at medium concentration, and hyperhydric swelling followed by death at very high concentrations. Tumor tissues, on the other hand, either showed no response at all or gave the rooting response characteristic for normal tissues when much lower concentrations were supplied than are generally necessary to elicit such a response (Gautheret, 1947a, b, 1948a, c). Gautheret (1939) had earlier shown that kohlrabi tissues taken from freshly harvested plants and placed on a simple medium lacking heteroauxin showed a rapid initial enlargement which was exclusively hyperhydric (Küster) and was not followed by growth, just as is the case with *Helianthus* tissues grown in a high heteroauxin nutrient; but that if the plants were stored for a month or so before use, their tissues showed no such enlargement on a simple medium and responded normally to added heteroauxin. All of these observations combined to suggest that tumor tissues might owe their autonomy to a heightened capacity to synthesize some auxin as compared to normal tissues. This hypothesis has been subjected to a direct test (isolation of growth substances and their assay by *Avena* test) by Kulescha and Gautheret (1948). Thimann and Skoog (1940) in an earlier study examined the auxins in *Nicotiana* tumors but made no parallel examination of other tumors or of non-tumor tissues grown under like conditions. The question has been approached indirectly by de Ropp, and by Camus and Gautheret. De Ropp (1948a) placed bits of tissues from various sources in close proximity to one another and on a simple nutrient in such a way that in growing they would fuse (graft) with one another. When two bits of normal tissue were

thus grafted, they both continued to respond as normal tissue and would not grow for long. When, however, one of the bits of tissue came from a strain of tumor cells capable of continued growth on this medium, the grafted bit of normal tissue would also grow, taking on the morphological appearance and growth pattern of the tumor tissue. Moreover, in one experiment (which needs to be repeated!), he was able to isolate from what appeared to be the transformed tissue of normal origin a strain of tissue cultures which now proliferates on such a simple medium at a very rapid rate. This is one of our most rapidly growing strains (strain "K") and if its origin was really from the normal tissue and not from invading or scattered cells of the original tumor bit (a question which it is difficult to answer positively), it would show that the presence of tumor tissue can, in fact, impart tumor properties to a bit of contiguous normal tissue. Camus and Gautheret (1948b, c, d) have repeated this general procedure, using tissue cultures of normal, habituated, and crown gall tissues, grown in vitro on fairly large pieces of chicory or artichoke tissue, and have concluded that under these conditions there is likewise a change in the character of the subjacent tissues, a change which may become permanent.

Such a change could come about in two ways. It might arise from transmission of a virus from tumor to healthy tissue, a possibility in favor of which there is no other evidence, and against which is the great mass of evidence that tissues adjacent to tumor grafts made on intact plants have *never* in our experience become tumorous. It might also come about by "habituation" in vitro, the tumor tissue serving as a source of heteroauxin to which the normal tissue becomes "habituated" (see below). That this sort of thing has never been observed on intact plants but only on bits grown in vitro seems strange. Perhaps the intact plant is able to remove or destroy the heteroauxin at a faster rate than can an isolated bit of tissue. The fact that tertiary tumors have never been observed on plants on which graft tumors have been produced would indicate that there is a fundamental difference in metabolism between the primary tumor-bacteria complex and the bacteria-free secondary tumor. Whether this difference is qualitative or only quantitative is not yet clear. This entire matter is of sufficient importance to warrant extensive study.

Normal tissues in vitro. The study of normal tissues and their subjection to possible tumefacient and antitumefacient treatments in vitro constitutes a third approach. Studies of this sort have been largely under the direction of Roger Gautheret at the Sorbonne in Paris.

Tissue cultures of animal tissues have provided us with unexpectedly little precise information on the differences between normal and tumor tissues or on the nature of tumorigenesis beyond what was available from other methods of investigation. It has, however, given us at least two cases of unequivocal carcinogenesis in vitro which, when they can be properly controlled and interpreted, should permit an exact study of these processes. These occurred in the work of Firor and Gey (1945) in which strains of malignant cells appeared spontaneously in a series of cultures of presumably normal tissues of the rat, without apparent cause, and in that of Earle (1943) in which malignant cells likewise appeared in cultures of mouse tissues but under conditions where the cultures might have been contaminated with methylcholanthrene. Whatever the cause, it is clear that the change from normal to malignant cells can go on under the relatively easily defined and controlled conditions of growth in vitro, and that it should eventually be possible to study the nature of this change in considerable detail.

Our present methods permit considerably greater precision in the study of plant tissues in vitro than of animal cells. It is therefore of considerable interest to know whether the process of tumefaction can go on in plant tissues in vitro, that is to say, whether there are processes in plant tissues which are truly analogous to the observed carcinogenesis in animal tissues in vitro. This requires a clear picture of the behavior of both normal and tumorous plant cells.

As early as 1931, Nobécourt had tried unsuccessfully to cultivate bits of carrot tissue in vitro (Nobécourt, 1937a). In 1934, Gautheret reported somewhat better results with tissues of *Salix*, *Populus*, and other trees, but was still unable to establish permanent strains. In 1937, both Nobécourt and Gautheret returned to the study of carrot tissues (see also Berthelot and Amoureux, 1937). By a combination of methods, the use of Berthelot's (1934) accessory salt solution, first introduced by Nobécourt (1937a), the addition of indoleacetic acid suggested by Gautheret (1938) and other modifications of earlier methods, both investigators independently and by somewhat dif-

ferent procedures succeeded in demonstrating the possibility of obtaining unlimited survival and growth of these tissues (Gautheret, 1939, 1940; Nobécourt, 1938, 1939). Nobécourt has subsequently studied the metabolism of this tissue and has grown tissues of a number of other plants. Particularly noteworthy is his demonstration that tissues of the rose can be grown from the start without heteroauxin (Nobécourt and Köfler, 1946). Whether this is different from Gautheret's "habituation" is not entirely clear. Gautheret and his students, particularly Morel and Camus, have carried out a broad program of research, have grown tissues of some 30 different species, including dicotyledons, monocotyledons, and ferns, and have shown that there is a considerable range of requirements for, and responses to, the different vitamins and auxins. Some of these studies carry important implications for the whole question of tumefaction in plants.

Plant tissues differ widely in their responses to growth substances. As we have seen, tumor tissues in general manufacture their own supplies in quantities sufficient to support a rapid rate of increase. Tissues of freshly harvested kohlrabi carry considerable supplies, which, however, are not renewed in culture. Most normal tissues manufacture little or no growth substances, and require external supplies when grown in vitro. A few tissues, however, upon prolonged cultivation on a medium containing growth-substance, undergo a curious change which bears a very suggestive resemblance to the tumefaction studied in vivo by Braun and Laskaris (1942). If tissues of carrot are freshly isolated and placed on two nutrients, one containing only salts and carbohydrate, the other containing indoleacetic acid at a concentration of about 10^{-6}, both tissues will grow for a time. After a month or so, however, the first group will gradually lose its vitality and only the second can be maintained. If, after two to four months, bits of tissue grown on an IAA medium are transferred to the simple salt-carbohydrate medium, they will quickly cease growing and ultimately die. But if this process of testing is repeated month after month, there ultimately comes a point at which such transfers no longer die, but continue to develop in a manner similar to that observed on the more complex medium. This change is usually accompanied by an increase in growth rate and a change in appearance on the complex medium, the cultures becoming more uniform in texture and somewhat translucent in appearance (Gautheret, 1947c; Morel, 1947). They have acquired a capacity to live without an external supply of indoleacetic acid and may be presumed to be now manufacturing their own. This phenomenon, which Gautheret has called "accoutumance" and which I have translated as "habituation" (to absence of heteroauxin) bears a striking resemblance to tumefaction. Camus and Gautheret (1948b, c, d) have shown that these tissues, when grafted onto bits of normal tissue, induce a response suggestive of a high auxin content and approaching that produced by aseptic crown gall tissue. It is clear that a permanent and fundamental change has taken place in the metabolism of the cells which make up the mass of the surviving culture.

How this change has come about is not clear. There appear to be two main possibilities, both of which have their counterparts in the theories of animal tumefaction. Their difference lies in the direction of emphasis. One theory postulates a mutation in the tumor cell itself. The other postulates a change in the cellular environment which permits the expression of qualities already resident in the tumorigenic cell, the cell itself undergoing no change. The first may be called the "mutation" theory. The genic constitution of the cells is supposed to have undergone an alteration which is irreversible. In this respect they resemble the metabolic mutants of *Neurospora* studied so extensively in recent years. The habituated or tumor cells have acquired the capacity to produce in excess a growth substance which is not produced in equal amount by the "wild type" cell. There are, however, two fundamental differences between this and what occurs in *Neurospora*. In the first place all of the observed changes in *Neurospora* involve *losses* of synthetic capacities, losses of the abilities to synthesize vitamins or other metabolic intermediates which are normal products of metabolism in the "wild type," while in our plant tissues there has been, not a loss, but a *gain* in such synthetic capacity. In the second place, in *Neurospora* there are many different recognizable mutations so that there is no appearance of direction in the change, while in our plant tissues we have recognized only *one* such mutation, which occurs in many different species of plants, repeatedly, but always in the same direction. This apparent unidirectional character is difficult to understand. It may, indeed, be quite spurious. The wild type carrot cell produces all of its growth substance re-

quirements except auxin (Nobécourt, 1942, 1943). Morel (1946b, d) has shown that other plants, particularly the woody species (*Crataegus*), have less complete synthetic systems and may require calcium pantothenate, biotin (*Salix*, Gautheret, 1948b), or inositol, for example, in addition to auxin. These differences in requirement have been studied as between species, but the process of investigation is laborious. Kulescha and Gautheret (1947) have studied the varietal differences in proliferative power within the species *Helianthus tuberosa*. No effort has been made to determine if differences exist between strains arising within a single culture line of carrot tissues, for example. Our routine procedures would not detect any mutation involving loss of capacity to produce an *essential* substance, since such a loss would merely result in failure of the cells involved to grow, and would be attributed to poor technique. It is only when a mutation occurs in a dramatic direction, such as the production of a tumor or a new color pattern (sectorial chimaeras) (Jones, 1940), or when our experimental procedures have already established two channels from which to choose (presence or absence of auxin in standard nutrients), that we recognize its existence. This, however, is also true of our studies of mammalian somatic mutations. We recognize such mutations, in general, only when they involve alterations either of color patterns (birth marks, moles, melanotic areas) or of growth patterns (warts, tumors, hairy areas, cancers). Often the two are closely linked—witness the potential malignancy of melanotic warts. If, however, a body area were to mutate toward a loss of capacity to produce para-aminobenzoic acid, no method now available would ever reveal the existence of the mutation. It appears that Gautheret's "habituation" may in fact be a mutation of this sort initially involving only a single cell or a very few cells. This possibility is strengthened by Morel's (1946) observation that in the Virginia creeper (*Parthenocissus tricuspidata*) the change occurred suddenly after 14 months, and involved only "a very limited area of tissue," the remainder of the colony remaining unchanged.

But there is another possibility which primarily involves not the tumor cell itself so much as the surrounding cells. In the compact, highly organized tissues of a normally growing plant, and in the correspondingly organized tissues which quickly result when normal tissues are placed on the standard auxin-free nutrient, the development of each cell is rigorously controlled by its mechanical contacts with its neighbors. Any tendency to "get out of line" will be restrained, and cells which might have such tendencies are provided with little scope for their expression. One of the primary effects of adding heteroauxin either to the tissues of the intact plant in the form of tumefacient agents, or to the nutrient for the cultivation of excised tissues, is the marked disorganization, the mechanical loosening of the tissue. This loss of mechanical restraint, even though it is temporary and may of itself produce no permanent alteration in cell metabolism, would nevertheless permit any cells which possessed a metabolic or growth pattern that differed from other cells, to bring those patterns to a less restrained expression. A cell capable of survival without heteroauxin, whether this capacity had persisted for a long term ("embryonic rest") or was recently acquired (a mutation), might produce progeny that would gradually replace the progeny of the associated slower-growing cell lines, if that capacity were coupled with even a moderately superior proliferative capacity. A point would then be reached after which a return to a nutrient lacking auxins would no longer result in encapsulation of these cell colonies in organized tissues, and we would have isolated strains of independent cells, without the cells themselves having undergone any fundamental change in their own metabolism. It will be very important to find some means of determining which of these possible interpretations of "habituation" is correct, or if some other explanation is better. The fact remains that here we observe a phenomenon which appears to be quite analogous with the carcinogenesis in vitro observed in animal tissues by Gey and Earle.

DISCUSSION

From this rather general, cursory, and by no means exhaustive survey of the field of neoplastic growth in plants, it is clear that there exists a considerable range of such growths, of a variety of origins. Some of these possess characteristics which allow one to draw rather close analogies with animal and human tumors. These analogies exist only at the cellular level, not at all at those anatomical levels which are usually paramount in the clinical classifications of malignant growths. It is for this reason that they have been largely ignored by clinical pathologists.

One of the striking and probably significant

facts which emerges from this survey is the frequency with which the question of involvement of the growth substances of the auxin type has appeared, even when quite different aspects of the general problem have come under consideration. This pervasive undercurrent clearly seems to indicate that these auxins must play a basic role in neoplastic growth of plants even more pronounced, or at least more emphatically delineated, than that so well known in normal growth.

Although the first grossly visible effect of auxin is a modification of the extensibility of the cell wall (Heyn, 1931), there are less obvious effects antecedent to this. The earliest of these appears to be an acceleration in the rate of cytoplasmic streaming. This acceleration is closely dependent on the presence of an adequate carbohydrate supply (Thimann and Sweeney, 1937a, b). It is mediated through certain of the phosphorylating mechanisms, and hence is dependent on adequate supplies of inorganic phosphate (Bonner and Wildman, 1947). It is at least partly dependent on the presence of zinc (Skoog, 1940) and is highly sensitive to certain respiratory poisons (Thimann and Bonner, 1949; see also Skoog, 1944). Auxin movement in plants is a highly polar process, taking place from regions of high metabolic rate, (growing points and leaves, cambium layers, regions of tumor development, etc.,) toward regions of low metabolic rate (Went, 1928, 1932). These regions happen to be those in which the respiratory rate is high. The gradients also correspond rather closely to the distribution of electropotentials (Rosene and Lund, 1935, 1937), so that the flow of auxin is in the same direction as the flow of electrons. Whether there is a dependence of one gradient on the other, or merely coincidence, is not established. Attempts to reverse auxin flow by imposing potential gradients have not succeeded (Schrank, 1945, 1946). Electropotential gradients, however, can be suppressed or reversed by suitable manipulation of the conditions for oxidation. And the same conditions which tend to reverse electropotential gradients will also bring about the production of localized and limited intumescences at the place where the electropotential is nil (Berry, Gardiner, and Gilmartin, 1947). These are physically induced teratomas, and they may well represent the same sort of concentration of auxins, resulting from a shift in the diffusion gradients, as is represented by the secondary tumors which appear following inoculation with crown gall, and which appear to result from the complementary effects of two or more gradients. Methods of analyzing these problems are available and will eventually be applied when a sufficient number of competent investigators becomes interested in these particular questions.

It is interesting and perhaps significant that among all the characteristics which are reported to differentiate tumor tissues in animals from their normal counterparts, the only one which has received general recognition is the matter of respiratory pattern. This pattern does appear to be different in tumor and normal tissues (Warburg, 1926, 1928). As in plants, the respiration of animal tissues is closely dependent upon carbohydrate and inorganic phosphate supply and upon the catalysis of heavy metals, particularly iron and copper (in the blood), but also apparently on other heavy metals in certain organs, as is the case with zinc (pancreas), manganese, etc. It seems evident that if (as is by no means certain) tumefaction represents a single type of reaction in both plants and animals, investigation should be concentrated on those aspects of the reaction which are common to the two kingdoms, and those aspects which are *not* common, being less generally relevant, could better be left aside for more incidental study. The respiratory patterns, and those aspects of growth in animals which are comparable physiologically to auxin effects in plants, should be especially fruitful fields for investigation.

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THE MAUTHNERIAN APPARATUS IN THE ICHTHYOPSIDA; ITS NATURE AND FUNCTION AND CORRELATED PROBLEMS OF NEUROHISTOGENESIS

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INTRODUCTION

AFTER the investigations, made in 1859 by Mauthner, which led to the discovery of the two giant fibres in the spinal cord of *Esox lucius*, we can consider the two giant cells, from which these fibres originate, as a true functional system of nervous activity. This functional system, which is peculiar to the majority of fishes and amphibians, is formed by a single pair of symmetrical neurons of extremely large size, the cell bodies of which are located in the tegmentum of the medulla at the level of the VIIIth nerve root, and axons of which reach the tip of the neural cord, each running along the medial longitudinal fasciculus of opposite sides.

Since the first investigations, and especially since the wider comparative analysis made by Tagliani (1905), it has been clear that Mauthner's fibres are not present in all the species of Ichthyopsida. As we shall see later, this condition is very important for the functional interpretation of this bineuronal apparatus. The absence of a typical mauthnerian apparatus was noted in the Cyclostomata and, among fishes, in all the selachians and in some teleosteans, e.g., the Anguilloidea and Murenoidea (*Anguilla, Conger, Muraena, Congromuraena, Gymnotus, Ophyctlis*), in many bottom-living fishes, e.g., *Lophius, Uranoscopus*, and *Blennius*, and in tailless species, e.g., *Orthagoriscus*. Many exceptions were also found among urodele Amphibians, e.g., *Geotriton, Cryptobranchus, Siren, Proteus, Diemictilus*, and *Salamandra maculosa* (according to observations by Mason, 1879, 1888; Osborn, 1888; Koelliker, 1896; Klaussner, 1883; Gage, 1893; Tagliani, 1905; Beccari, 1907), while the M. (Mauthner) neurons were considered to be absent in all the anurans (Reissner 1864; Stieda, 1870; Sala, 1892; Koelliker, 1893, 1896; Athias, 1897; Van Geuchten, 1898; Gaupp, 1899; Tagliani, 1905).

Yet, in more recent years, with the help of better techniques, many of these statements had to be rectified. Thus Schmidt (1885) described the M. cells in *Proteus*, Tuerckheim (1903) and Kingsbury (1895) in *Cryptobranchus* and *Diemyctilus* (*Triturus*) and Szepsenwol (1935) in *Geotriton*. Also the belief in the absence of these neurons in the anurans was found to be erroneous, for Larsell (1935) found them in tadpoles of *Rana fusca* and *Bombinator pachypus* (their presence in *Rana fusca* having been recently confirmed by Willis, 1947) and Stefanelli described them in *Rana esculenta, Rana agilis*, and *Hyla arborea* at the larval stage (Stefanelli and Osti, 1942) and in tadpoles of *Discoglossus pictus, Hyla savignii*, and *Xenopus laevis* (1949). In tadpoles of *Rana esculenta* Stefanelli was also able to show a pair of premauthnerian giant cells, at the level of the Vth nerve root. On the other hand, the absence of a true mauthnerian apparatus in the Bufonida (*Bufo vulgaris* and *Bufo viridis*) was confirmed by Stefanelli (1949) and by Zacchei (1949).

A revised knowledge of the condition prevailing in the cyclostomes and teleosts brought a modification of many statements. In petromyzonts there are ten pairs of reticular giant cells, only one of which is homologous, as to location and connections, with the M. cells. Observations by De Angelis (in press) show the presence of the M. cells also in *Blennius* and in other species which, though typical bottom-living fishes, show an active movement of the tail in swimming (*Clinus, Gobius, Trachinus, Solea*).

The morphological and functional significance of the M. giant neurons was not easily understood, and for a long time, as we shall see later, many wrong ideas dominated the subject. Many anatomical, comparative, morpho-ecological and physiological researches were necessary to elucidate the enigmatic significance of these neurons, and only after the most recent results can we consider this question at last resolved.

Today the interest in the M. neurons goes beyond their morphological and functional significance and reaches the wider fields of the general problems of neurohistogenesis, because of the size of these elements, their easy localization, and their

peculiar shape at the time of complete differentiation.

The present review describes the work that has been done to reach our present knowledge of these neurons, and the experiments in which they have been used for the solution of histogenetical and morphogenetical problems in the field of experimental embryology. It emphasizes in particular the work of the Italian investigators of the Mauthner cells, and is not intended to be an exhaustive review of the subject.

STRUCTURE

It is indeed odd to note how the first investigators of the M. neurons, though struck by the exceptionally large diameter of the two fibres running within the spinal cord in fishes (they can reach 125 μ in diameter), were not likewise impressed by the large size of the two cells situated in the medulla. The two M. fibres were thus considered for many years to be a bundle of axons (Owsyanicow, 1894). Fritsch (1879) Stieda (1899), and Sanders (1879, 1898) proposed for them the term "multiaxial fibres." This idea was so deeply rooted that when Mayser in 1881 discovered the two giant cells in the medulla, he did not relate them to the two giant fibres. It was only in 1888 that Goronowitsch demonstrated the origin of the M. fibres, in the sturgeon, from the two giant cells situated at the level of the vestibular nerve. Yet in 1898 Kolster, still not convinced of this origin, attributed to the M. fibres a centripetal conduction and a sensory function!

Though many celebrated neurologists, such as Edinger (1897) and Koelliker (1895), still held the opinion that these fibres were multiaxial, other investigators confirmed their bulbar origin (Burkhardt, 1889; Haller, 1891), and Kingsbury (1897) was able to describe the dendritic relations of the giant cells with the acoustic area (vestibulo-lateral area) and to demonstrate the neurofibrillar nature of the giant fibres.

The question of the caudal ending of the M. fibres then arose. Burkhardt (1889) believed that the fibers divided caudally into three branches, each following one of the three last spinal nerve roots, and ending in the tail muscle. (A similar condition was later described by Leghissa (1940) in trout larvae, but there is now no doubt as to the central course of the M. fibres.) A motor function was attributed to these cells also by Haller (1898), who described each cell as supplied with five neurites, obviously considering the dendrites as axons.

An exact knowledge of the morphology of the M. neurons was reached only with the work of Tagliani (1905) and Beccari (1907). From the structural point of view these investigations established the following essential data: (1) the M. fibres are two big neurites running along the medial longitudinal fasciculus of the opposite side of their origin; (2) the M. fibres originate from two giant cells situated in the medulla oblongata at the level of the vestibular root, and shortly after their origin they decussate; (3) the M. cells are connected to the vestibulo-lateral area by means of dendrites and of synapses directly on the cellular body; the connection with motor centers is effected by means of direct synapses on the M. fibres; and (4) the connections of these cells with other nervous paths is effected by means of the pericellular basket (already observed by Mayser).

Among the more recent investigations bringing new contributions on the subject, (Tello, 1909; Herrick, 1914; Bartelmez, 1915; Coghill, 1929), those of Bartelmez are of a particular importance from the morphological point of view. He showed two of the most important dendritic connections in trout larvae: the connection of the lateral dendrite, which reaches the periphery by branching among the fibres of the vestibular root and the cells of the Deiters nucleus, and that of the ventral dendrites which largely branches in the neuropil formed by the ventrolateral column. A third dendrite, of median thickness, branches among the fibres of the medial longitudinal fasciculus. In *Ameiurus* the same author showed that the following connections exist: (a) with the root fibres of the VIIIth nerve; (b) with the arcuate fibres coming from the ventral vestibular nucleus; (c) with the collateral fibres of the tectobulbar tract; (d) with the cerebello-tegmental tract and with the nucleus trigeminalis principalis. According to Beccari (1907) and Herrick (1914) there is in urodeles a dorsal dendrite reaching the nucleus dorsalis of the acoustic area. In teleosts, according to Bartelmez, this dendrite is absent.

Great importance was attributed to the M. neurons for the study of the synapses, which here exhibit certain peculiar morphological conditions: the pericellular nest of Mayser, or basket of Beccari (1907), the axon cap of Bartelmez (1914) at the base of the emergence point of the axon, and the ending clubs of Marui (1918), Bartelmez and

Hoerr (1933), Bodian (1930) and Tiegs (1931). Beccari (1907) also described some synaptic buds on the basket and some peculiar synapses, along the course of the fibre, which he called axo-axonic and which were recently described also by Leghissa (1940, 1946). The nature of the synapses of the M. cell was also considered, from a critical point of view, by Boeke (1951) and by Barbey (1942).

Recent researches by Stefanelli (1950) have showed what a great difference there is in the complexity of the M. neurons in teleosts, urodeles, and anuran larvae (Fig. 1). Those of the teleosts exhibit the greatest complexity, considering both the size of the cells, the extension of the dendrites, and the nature of the synapses. Although there are some differences among species, there are always a difference of size, proportional to the body size, in the elements homologous to the M. cells and in the other tegmental giant cells in three species of lampreys of different body size (*Petromyzon marinus*, 85 cm. in length; *P. fluviatilis*, 25 cm., and *P. planeri*, 11 cm. The giant cells of the medio-lateral reticular nucleus, homologous to the M. cells, have the following sizes: *P. marinus*, 160 x 42 μ; *P. fluviatilis*, 120 x 50 μ; *P. planeri*, 100 x 48 μ). These data correspond exactly to the relation found by Levi (1905) between the nerve cell size and body size, during growth, and known as Levi's rule: the size of the nerve cell body is proportional to the extension of its prolongations, i. e., to the extension of the innervated area. This condition is a consequence of the fact that there is

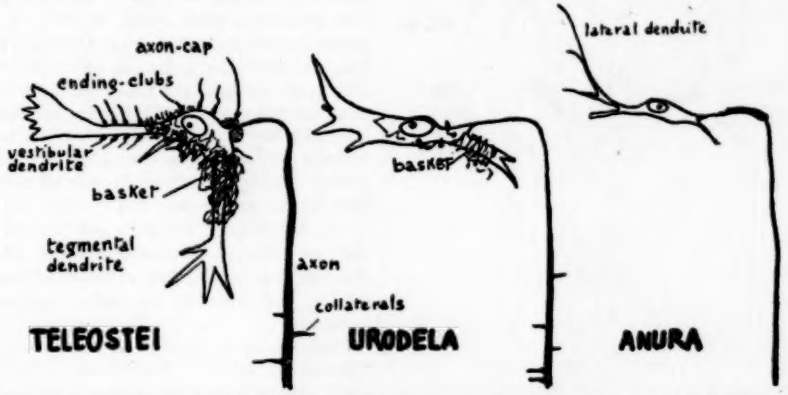

FIG. 1. THE DIFFERENT DEGREE OF DIFFERENTIATION REACHED BY THE MAUTHNER NEURONS IN ADULT TELEOSTS, URODELES AND LARVAL ANURANS

big dendrites, one lateral and one ventral, and many synaptic systems, such as the pericellular basket, the axon cap, the end-clubs, and, with the collaterals of the fibre, the axo-axonic synapses. In the urodeles only the basket is well formed, but the latero-dorsal dendrite (lacking in fishes) is well developed, and along the fibres there are axo-axonic synapses with the collaterals. In the anuran larvae there is a slight indication of a basket, and the only dendrite of large size is the latero-dorsal one; along the fibre no collaterals can be observed. The cell size in urodeles is smaller than in teleosts, and is even smaller in anurans (Fig. 1). The significance to be attributed to these differences will be considered shortly.

Stefanelli (1932, 1933) earlier showed that there a fixed number of nerve cells, inasmuch as these are perennial elements, as the well known researches by Bizzozzero (1843) clearly showed.

The relation between cell size and body size has also been observed in the M. cells by Stefanelli (unpublished) in three species of salmonids of different body size when adult (3 years old: *Salmo lacustris*, 40 cm. long, *S. fario*, 23 cm. long and *S. iridaeus*, 20 cm. long; cell size respectively: 197 x 150, 152 x 101, 120 x 98 μ).

An analysis of the size of the M. cell during larval development in the frog showed (Stefanelli, 1947c) that the size of these cells is not only related to body size, but also to the developmental stage, as seen from comparing larvae of the same

size but of different stages, due to maintenance upon different diets.

COMPARATIVE ANATOMY: MORPHOLOGICAL SIGNIFICANCE

The morphological significance of the M. neurons is of great importance for the understanding of their functional significance, but it was not

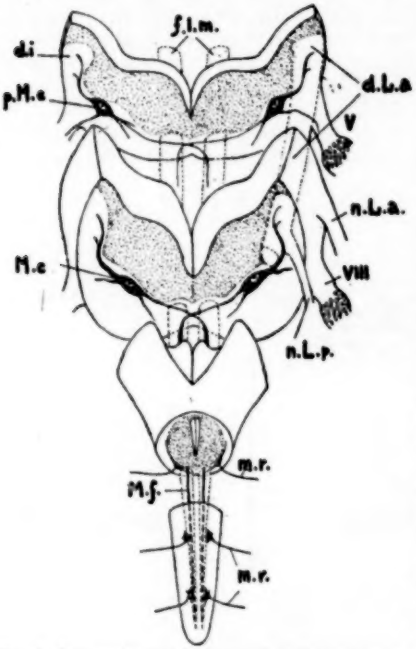

FIG. 2. SCHEME OF THE MAUTHNERIAN APPARATUS OF A FROG TADPOLE AND ITS RELATIONS WITH THE PREMAUTHNERIAN CELLS

d.i., dorsal island; f.l.m., medial longitudinal fascicle; d.L.a., dorsal lateral area; p.M.c., premauthnerian cells; M.c., mauthnerian cells; n.L.a. and n.L.p., anterior and posterior lateral nerves; M.f., Mauthner's fibres; m.r., motor spinal roots.

easily ascertained, and many interpretations were given, particularly by the earliest investigators. Thus, while the M. cells were at first considered as a particular differentiation of the vestibular centers (although Tagliani, 1905, clearly understood their functional relation to the movements of trunk and tail in swimming), Beccari (1907) suggested their derivation from the reticular elements of the tegmentum motorium. A further clarification was made by Bartelmez (1915), who showed the similarity of the M. cells in *Ameiurus* to the other tegmental cells, which also are of large size. The derivation of the M. cells from the cells of the tegmentum motorium was clearly demonstrated by Stefanelli (1949a, b) through comparative studies of petromyzonts, teleosts, and anuran amphibians. In the petromyzonts the tegmentum motorium is formed by a large number of reticular cells, of which at least ten pairs are always easily found, owing to their large body size and their constant location, in all the individuals of the three species studied, *Petromyzon marinus*, *P. fluviatilis* and, *P. planeri*. One of these ten pairs is homologous, from its location and connections, with the M. cells, but its morphological characteristics are similar to those of the other giant pairs (Stefanelli, 1933, 1934). Similarly, in the eels the tegmentum motorium has 17 pairs of giant cells, always constant in location and form (Stefanelli, 1944; Stefanelli and Camposano, 1945). Of these, one pair corresponds in location and connections with the M. cells, though their size is not different from that of the other giant cells, and is smaller than in the typical M. cells of teleosts. Both in the petromyzonts and the eels, the pair of cells corresponding to the M. cells does not produce any fibre of remarkable size (M. fibres). Their axons unite with those of the other reticular cells as components of the medial longitudinal fasciculus.

Further proof was provided by the study of M. apparatus in larvae of *Rana esculenta*. Stefanelli (1942) showed that in this species, besides the pair of M. cells at the level of the vestibular root, there is another pair of giant reticular cells (almost of the same size) situated at the level of the trigeminal root (Fig. 2). In other anurans, such as the Bufonida, the M. cells are, on the contrary, absent, but in some individuals it is easy to find in their place some reticular element larger than other bubar elelments.

The premauthnerian cells of the frog do not produce giant axons similar to the M. fibres; one dendrite of each follows the fibres of the Vth nerve root peripherally. In other species (*Hyla*, *Discoglossus*) in place of these cells there is a variable number of smaller cells.

These comparative data demonstrate very clearly that the M. cells are elements of the tegmentum motorium which, in relation to particular stimuli from the lateral vestibular area, have differentiated

in a particular way. Their strong functional activity is shown by the very great size they can attain, just as if their function, which in other animals is performed by the various tegmental centers, were here concentrated in the two cells. Fig. 3 shows this functional centralization in a series of Ichthyopsida.

FUNCTION

Passing over the old ideas of Oswianikow (1854) and Stieda (1861, 1867), who considered the M. fibres as commissural fibres, and those of Fritsch (1879) Sanders (1879), Haller (1895), and Kolster (1898), already briefly reported, we find the basis of our present concept in the works of Tagliani (1905).

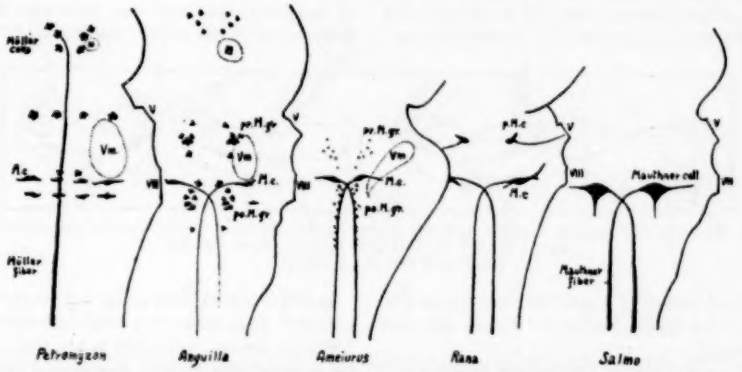

FIG. 3. MAUTHNER'S CELLS AND GIANT CELLS OF THE NUCLEUS MOTORIUS TEGMENTI IN A SERIES OF ICHTHYOPSIDA
Original figures except for the diagram of *Ameiurus*, after Bartelmez (1915).

This author, referring to the morphological condition of the M. fibres (he did not consider the cells) in different Ichthyopsida, found that the development of these fibres is related to the activity of the swimming movement due to the orthotonic movements of trunk and tail, and therefore to the general form of the body. In fact, as was briefly recounted in the introduction, these fibres are lacking in bottom dwelling fishes, in tailless fishes, and in those having an eel-like movement. Also, the condition found in amphibians (the urodeles having the M. apparatus while the anurans lack it) was considered a confirmation of this thesis. Beccari (1907) too accepted this functional interpretation, and, considering the tegmental origin of these cells, attributed to them, besides the function of coordinating the swimming movements with the orthotonic movements of trunk and tail, also an automatic initial motor activity, this being the function of the bulbar tegmental centers in the lower Vertebrata. Two years later Tello (1909) concurred in this interpretation. Herrick (1914) confirmed Beccari's view, noting that in the Ichthyopsida swimming by means of trunk and tail muscle, the M. apparatus can be stimulated from the periphery through the vestibular and lateral nerves, centrally through the ascendent (spinobulbar) or descendent (tectobulbar) tracts and the medial longitudinal fasciculus, and locally by the other elements of the tegmentum motorium.

An interesting and original interpretation was given by Coghill (1926, 1935) who, while admitting for these elements a function in swimming, attributed to them an inhibitory activity instead of an excitatory one, basing this interpretation on the fact that along the spinal cord M. axons have not only connections with motor elements, but also with intercalary cells.

Szepsenwol (1935), studying normal ontogenetic differentiation, considered the relation of these neurons to swimming activity to be evident. By a similar but more complete analysis, Leghissa (1941) confirmed this point of view (in *Amblystoma* larvae), and added that the M. neuron is not a simple intercalary neuron of a reflex arc, but a true motor associative center.

The functional significance of the M. neuron was studied experimentally by Detwiler (1927a, 1933, 1947a), who removed one or both M. cells in *Amblystoma* larvae, and compared the behavior

of the operated animals with normal ones, and with larvae in which one or both otic vesicles had been removed. The results of these experiments confirmed the importance of the M. cells in swimming, as coordinators of the cephalo-caudal progression of the flexory activity of the trunk and tail. Yet, as Stefanelli (1946, 1947c) also observed by similar experiments in *Rana* larvae, the functional defects soon disappear. In effect, while after removal of the M. cells the difficulty in swimming appears after three days (when the operation has been performed at the tail-bud stage), after removal of the otic vesicle they appear after 8 days; but, whereas in the latter larvae the defect persisted for more than 33 days, larvae deprived of the M. cells soon recovered and after only 8 days behaved quite normally. Considering the fact that at the stage of the operation (17 of Harrison) the M. cells do not regenerate, it is necessary to suppose the existence of a substitute nervous mechanism of the type considered by Coghill for other phenomena.

This functional regulative process, together with the difficulty of performing exactly delimited operations without injuring other regions, prevents us from considering the experimental physiological analysis as being the most significant method of reaching a conclusion regarding the physiology of the M. apparatus. These results are nevertheless important if compared with the data obtained by morphological and comparative methods and from a morpho-ecological analysis. This last method, used for the first time by Tagliani (1905) in his comparative analysis of the presence or absence of the M. cells in tailless fishes, or in fishes living at the bottom or showing eel-like movements, was later more extensively utilized by Stefanelli, both in making a comparison of the eel-like forms (eels, petromyzonts) in which he found common conditions for the presence of many giant cells in the tegmentum, and in studying the development of the M. cells in anurans during their larval life and metamorphosis, and in urodeles.

The anuran amphibians studied by Stefanelli (1949a) may be subdivided, according to their ecological conditions, into three groups: (a) tadpoles with a small tail and a narrow fin and with a scarcely developed lateral line, and adults highly adapted to terrestrial life (*Bufo vulgaris, B. viridis*); (b) larvae with a large tail and a well-developed lateral line, and adults which, although adapted to terrestrial life, frequently retain their relation to the aquatic environment (in these forms the lateral line disappears at metamorphosis) (*Rana esculenta, Hyla arborea, Discoglossus pictus*); and (c) larvae with a very large tail and a highly developed lateral line and adults so adapted to aquatic life that the lateral line not only does not become reduced at metamorphosis, but even undergoes further development in the adults (*Xenopus laevis*).

FIG. 4. MAUTHNER'S CELLS OF VARIOUS ANURANS IN THE LARVAL STAGE, SHOWING THE RELATIONSHIP TO THE DEVELOPMENT OF TAIL AND LATERAL LINE ORGANS
The lateral line area is dotted.

In tadpoles of the first group, the absence of M. cells and their fibres was confirmed (Stefanelli, 1949a, b; Zacchei, 1949); but in some animals, in the corresponding location, homologous tegmental cells may be observed. The M. apparatus on the contrary is present and well developed in the tadpoles of the second group, though much simpler than in teleosts; the laterodorsal dendrite reaching the dorsal island of Kinsbury, an eminently lateral area, is the most developed. In the larvae of the third group the M. apparatus has an even more remarkable development (Fig. 4).

But a better proof of the importance of the M. apparatus in the swimming function is given by its different fate at metamorphosis, when the animals of groups (a) and (b) lose the tail and lateral system, and become terrestrial, whereas those of group (c) lose the tail but keep the lateral line. Larsell (1934) had already observed that in *Rana pipiens*, with metamorphosis and transition to terrestrial life, the M. cells become atrophied, while the cochlear centers develop from the lateral

centers. The atrophy of the M. cells was then observed by Stefanelli (1949a, 1950a), although he noted that this atrophy does not appear directly after metamorphosis, but gradually and many months later, being completed only toward the end of growth (Fig. 5). This explains a case, recorded by Beccari (1934), of the presence of a reduced M. cell in an adult frog.

The simplest interpretation of the cause of the involution of these neurons would be that the atrophy of M. cells is related to the atrophy of the lateral line system, with which each M. cell has a dendritic connection. But recent observations by Stefanelli (1949b) have shown that the M. cell undergoes atrophy also in *Xenopus*, in which the lateral line develops even further after metamorphosis. It may be concluded that the M. apparatus can exist only when both the sensory system of the lateral line and the motor system of the tail are present. The absence or slight development of only one of these systems is sufficient to allow the involution or non-differentiation of the connecting M. neurons, as in adult *Xenopus* or larval *Bufo*.

Another interesting observation on the function of the M. cells was made by Stefanelli in some urodeles that during certain periods of the year are aquatic but which aestivate and hibernate out of the water. His preliminary observations on *Triton cristatus* showed that the M. cell is larger in size during the aquatic than during the terrestrial phase, thus showing a cyclical functional hypertrophy (1950a).

The different rate of differentiation shown by the M. apparatus in teleosts, urodeles, and anurans (Fig. 1) is a further proof that its function is related to the activity of swimming by movements of the tail and is directly connected with the lateral line so as to establish a reflex activity involving this sense organ, peculiar to the aquatic Ichthyopsida.

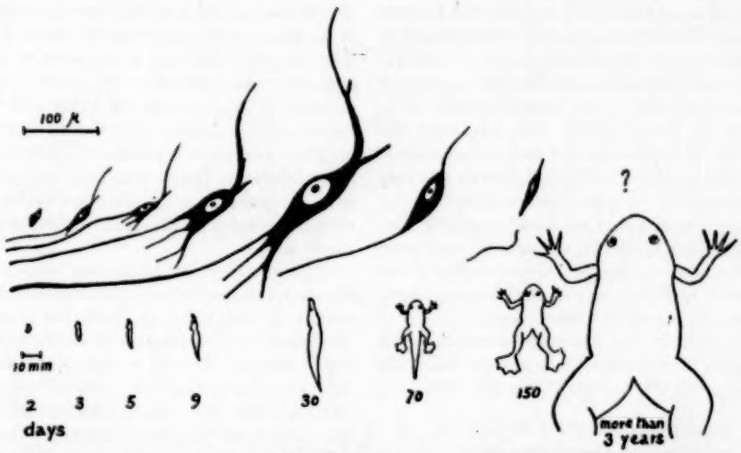

FIG. 5. EVOLUTION AND INVOLUTION OF THE MAUTHNERIAN APPARATUS OF XENOPUS LAEVIS DURING LARVAL LIFE AND AFTER METAMORPHOSIS

It is to be noted that the lateral line system of this species of anuran does not degenerate after metamorphosis, owing to the great adaptation to aquatic life of the adults.

NEUROHISTOGENESIS

Normal development

The problem of the ontogenetic development of the M. neurons was attacked by studying successive stages of development, and experimentally by exposing the presumptive M. neuron anlage, before differentiation, to various experimental conditions.

Szepsenwol (1936), through an analysis of the histological aspect of these cells in *Amblystoma*, by a silver method, reached the conclusion that the neurofibrillar differentiation is mostly determined by the peripheral activity, and considered doubtful the action of any hereditary or predeterminating factors. Owing to the fact that before hatching the

embryos are excitable, although no neurofibrillar formation is apparent in their M. cells at the time, this author thought that the essential factor for neurofibrillation is the swimming activity, which starts when the larva is 7 mm. in length.

More recently Leghissa (1941), working on larval *Amblystoma*, stated that the M. cell appears at stage 35 (Harrison) as a cell of the nucleus motorius tegmenti. Neurofibrillae appear at stage 37, when the larvae show Coghill's reaction, that is, long before the beginning of the swimming activity. However, Leghissa also, though demonstrating that the determination process is antecedent to stage 35 and is independent of nervous impulses, admitted that further differentiation is dependent upon central and peripheral activity.

The same conclusions regarding the existence of an extrinsic action on neurofibrillation were reached by Weber (1940), who considered the axon-cap as formed by the medial longitudinal fasciculus, and by Greene (1947), who showed that there is a synchronous development of the dendritic field together with the total reaction paths of Coghill. According to Greene, the axon does not grow caudally until the complete differentiation of the peripheral receptors, such as the acoustico-lateral ganglia and organs, has taken place.

A serial study was also made in anuran larvae during their metamorphosis, in order to follow the destiny of the M. neurons (Stefanelli, 1950).

Experimental analysis of the factors of histogenetic determination and of differentiation

Owing to their peculiar characteristics, the M. neurons of the Ichthyopsida have proved to be a very favorable material for experimental researches on problems of neurohistogenesis, such as histogenetic determination, the growth of the cells, and the specific differentiation and orientation of their prolongations.

Holtfreter (1931) casually observed the presence of a large cellular body in fragments explanted from a young gastrula of *Amblystoma*, and suggested the possibility that it was a mauthnerian element. This was the first observation showing an autonomous differentiation of the M. neuron, and required confirmation. Detwiler also (1927) in some experiments on the morphogenesis of the medulla oblongata in *Amblystoma*, happened to find in heterotopic grafts of oblongata some large cells which he recognized as M. cells. A study directly connected with the specific differentiation of neurons was made by Piatt (1945), who found, in explants of neural plate (in *Amblystoma* embryos operated at stage 15) some cells which he could identify as M. cells. These experiments suggested that in the amphibians (*Amblystoma*) the determination of specific nervous cells might already be in progress at the gastrula or young neurula stage (Piatt, 1948). Other investigations by Detwiler (1927b, 1933) seemed to support the possibility that the M. cells can also regenerate when removed at stages 27–29; but later the same author (1944, 1946, 1947b) showed that unilateral removal of half the medulla is followed by the restitution of the lacking part and by the restoration of bilateral symmetry, but with a deficiency of the M. cells. This was explained by the author as a consequence of the fact that the VIIth and VIIIth nerve roots are lacking after the operation, basing this conclusion on investigations of Piatt (1947) which seemed to demonstrate that the peripheral stimulus coming from the VIIth and VIIIth nerve roots is the factor for the specific differentiation of the M. cells.

While these investigations were being done in the United States, in Italy Stefanelli completed a series of investigations to clarify the identity of the factors in the histogenetic determination of the M. neurons. He tried to discriminate between the intrinsic factors and the extrinsic factors which which act later and cause the specific differentiation. Only after the reestablishment of the international exchange of scientific information between investigators of the two countries was it possible to draw any general conclusions from all the data. Preliminary notes by Stefanelli were printed in 1945, and the complete paper was presented at the Accademia dei Lincei in January 1946 (Stefanelli, 1947c). A paper on explants also appeared in this year (Stefanelli, 1947b). The method used in these investigations was the isolation, at different developmental stages, of the presumptive anlagen of the M. cells, followed by histological study, using the silver method, of the differentiation of the operated region and of the isolated fragment. Isolation was obtained both by transplantation to a cavity of a host embryo (coelom or neural cavity) or by explantation into physiological saline solution (Fig. 6).

The results of these experiments were the following: If the presumptive zone of development of an M. cell was removed at stage 12 (Fig. 6a) (actu-

ally, since identification of this area is difficult at this stage, a larger area was divided into a number of regions which were separately removed from different embryos), in all cases a normal M. cell differentiated in the donor. The brain of the donor underwent complete repair, with no morphological or histological deficiencies. The isolated fragment always differentiated into nervous tissue, but no cell ever appeared that had even a slight resemblance to an M. cell. If it was small the explant egulated to form a solid ball with the cells situated at the periphery; or, if it was larger, a hollow sphere with the cells directed towards the internal cavity. The form of a solid or a hollow sphere appeared independently of the presence of mesenchyme; that is, the form of the explant is not conditioned by the presence of mesenchyme, contrary to Holtfreter (1934), but by the explant's size. Besides, in these fragments (transplants and explants) no differentiation was noted other than that of nervous tissue, though there were no specific elements, nor ever any differentiated epithelium, connective tissue, or ganglian cells, etc., such as Damas (1947) found in explants from *Xenopus* gastrulae. In the latter experiments not only the difference of species, but also the very small size of the explants made, needs to be considered.

We can therefore conclude that, in the frog at stage 12, the medullary plate is already determined as nervous tissue, but still lacks any special determination of an M. cell field.

In cases operated at stage 13 (Fig. 6b), the results are similar to those of the preceding group, but in some cases an M. cell differentiated in the operated region, and in the explant there developed a second, which by its size and processes was identifiable as an M. cell.

In cases operated at more advanced stages (Fig. 6c–e), up to the tail bud stage (stage 17), the operated medulla always underwent a more or less complete morphological repair, but always remained histologically deficent as respects the M. cell. In many cases the vestibulo-lateral organs, ganglia, and roots were present. In the isolated fragments from these stages it was always possible to observe, among the other cells, a large

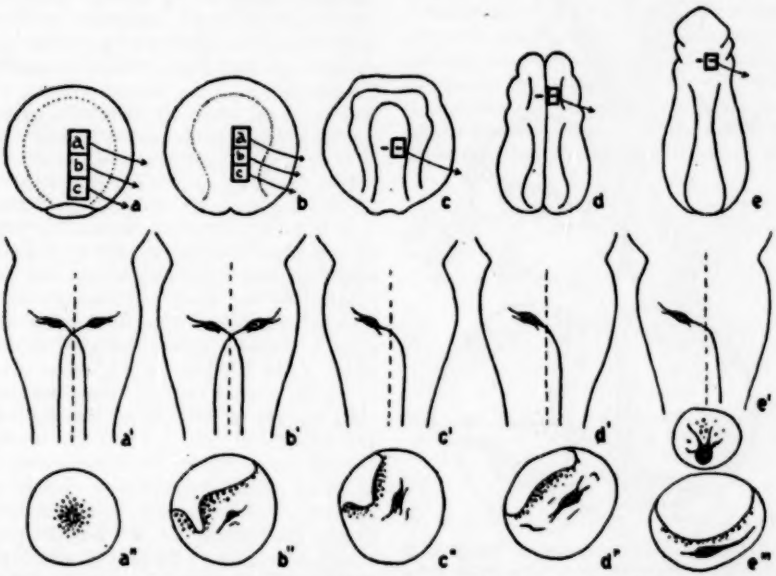

FIG. 6. THE RESULTS OF EXPERIMENTAL ABLATION OF THE MAUTHNER'S CELL ANLAGE IN DIFFERENT EMBRYONIC STAGES OF THE FROG (UPPER ROW), THE REGENERATIVE OR REGULATIVE PROCESSES IN THE MEDULLA (MIDDLE ROW), AND THE DEGREE OF DIFFERENTIATION, BOTH MORPHOGENETIC AND HISTOGENETIC, OF THE ISOLATED BITS OF TISSUE IN THE BODY CAVITY OF A HOST OR IN VITRO (LOWER ROW)

nervous cell with large dendrites easily recognizable as an M. cell. The excision of VIIth and VIIIth nerve roots and ganglia failed to modify the structure of the M. cell.

Other investigations by Stefanelli (1948a) showed that at stage 17 there can be no histological regulation parallel to the morphological: for by transplanting a skin fragment in the medial

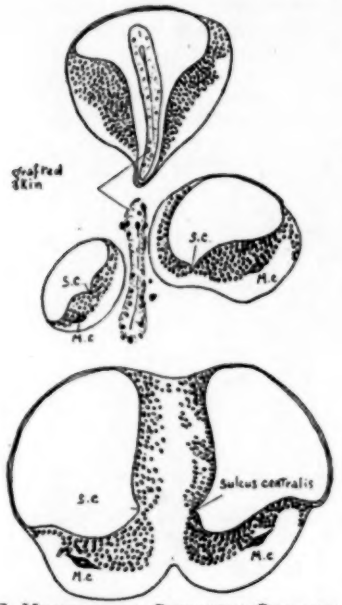

FIG. 7. MORPHOLOGICAL REGULATION PROCESSES IN THE LARVAL MEDULLA OF A FROG AFTER THE IMPLANTATION IN THE MIDLINE OF A PIECE OF SKIN (TAKEN FROM AN EMBRYO OF THE SAME AGE)

The two half-medullas each regulate so as to produce a contralateral part (more or less well developed), and provoke a duplication of this neuraxial segment. Morphological regulation is not followed by histogenetical regulation, and only the two normal Mauthner's cells become differentiated.

sagittal line of the medulla oblongata, a duplication was obtained; the two halves regulating to form a more or less extended contralateral part; and yet in each regulated medulla only the M. cell of the original side differentiated (Fig. 7).

The conclusions drawn by the author from these experiments were: (1) the histogenetic determination of the M. cell in the frog occurs at stage 13; (2) the histogenetic determination is a process of some duration, but also a shorter time is sufficient for the determination, so that when an element is removed, another element falling within this histogenetic determination field becomes similarly determined (cases of double formation); (3) two consecutive actions come into play in the histogenetic determination of the nervous cells: (a) "general histogenetic determination," owing to which the cells acquire the value of nervous cells with general characters, and a "particular histogenetic determination," which in the different histogenetic fields contributes to the neurons their particular, highly differentiated character; (4) once they have undergone the second phase of determination, the neuroblasts, even when isolated, manifest their intrinsic nature (which can be homologized with the "hereditary organization" of Herrick, 1925), in so far as the experimental conditions allow.

From these conclusions it may be deduced that extrinsic stimuli affecting the particular differentiation of the M. cell act in a positive way only in the earliest period of the particular determination, conditioning the fields of the histogenetic determination and their topography. Particular interest therefore attaches to those experiments which produce, in more or less extended fields, the determining action, and give rise to a certain number of specific nervous elements. These phenomena must therefore be distinguished from the hyper- and hypo-plasiae, provoked in a late period of development in already differentiated cells, and producing cellular hypertrophy or atrophy. (See Hamburger and Levi-Montalcini, 1949; Stefanelli, 1950b). The interpretation of a determination of already differentiated cells, given by some authors to results of operations performed in advanced stages, is therefore scarcely plausible, and the experiments that suggest a late determination of the M. cells (Piatt, 1947; Greene, 1947; Oppenheimer, 1941) must be interpreted differently.

When the mauthnerian neuroblast is isolated, as in the experiments by Stefanelli, after its period of particular determination, by removing the otic vesicle, the peripheral organ with which it is most directly connected or by cutting the neural axis anterior to the M. cells, or posterior to them, or by transplanting or explanting it in physiological solution, then the region always differentiated so as to reveal an M. cell. Yet, in some conditions, as Stefanelli noted, this M. cell did not appear to be perfectly normal, but showed some alterations of

size and form. Stefanelli and his collaborators (Rossetti, 1947; Forti, 1947) observed that the form and size of the isolated fragment influences the form of the M. neuron it contains (Fig. 8). The size of the fragment allows a greater or lesser morphogenetic regulation, giving rise to a solid ball or to a hollow sphere, or to a vesicle in which part of the wall is thin and there is a cavity similar to the ventricular cavity owing to a regulative process that forms a more or less extended contralateral part. (Note that the fragments were always removed from one side only of the medulla.) In fragments regulated to form a solid ball (Fig. 8a), the M. cell was situated in the central part; while in the vesicular fragments (Fig. 8, b, c) its position was similar to the normal position in the medulla. In the same way its form in the ball-like explants was roundish, in the vesicular explants it was fusiform and more normal in shape. The spatial condition must therefore be considered as an extrinsic factor conditioning the differentiation.

The form of a neuron is in addition characterized by the number, the extension, and the orientation of its neurite and dendrites. In isolated fragments the spatial limitation prevents normal development of the prolongations (which is in reality limited, as we shall see, by other factors). This not only directly modifies the form, but acts also indirectly, for the cell body, so limited in the realization of its "potential of prolongations" (Stefanelli, 1947c), undergoes less development than normal and retains a roundish shape. This fact appeared very clearly when the neural axis was cut caudally to the chiasma of the M. fibres, preventing the caudal growth of the neurite: the cell, though in its normal position and without spatial limitations, remained small and roundish.

Another factor considered in these experiments is the trophic factor. Limited food supply influences the development of the nervous cells. This became apparent when a comparison was made between the M. cells of larvae of the same age but of a different stage of development, and the M. cells of larvae of different age but of the same size. In the explants the trophic factors are even more limited, and this condition must be taken into consideration.

The ectopic transplantations of mauthnerian neuroblasts (Piatt, 1943; Stefanelli, 1947c) showed that a nervous activity unfavorable to the nature of the M. cells can cause atrophy of the inactive cell more rapidly than inactivity alone.

The general conclusion of these investigations is that the particular differentiation of a neuron is due to its intrinsic quality induced by the "particular determination," and that the extrinsic factors acting later can favor or limit development, which tends to follow the inherent potencies. Though a very imperfect example, we might consider as a parallel case the action on a developing seed of environmental factors (constitution of the soil, nutrition, etc.) which modify the particular morphological shape intrinsically contained in the seed.

Nevertheless, as we shall see, the extrinsic factors are very important in determining the development and orientation of the prolongations of the nervous cells (axons and dendrites), in the same way as the conditions of dampness and nutrition in the soil can determine the particular size and direction of growth of the roots of a plant, but always within the limits of the possibility of the specific nature of these roots.

FIG. 8. THE SHAPES OF ISOLATED MAUTHNER'S CELLS IN VITRO (*a*, *b*, *c*) IN RELATION TO THE SIZE AND SHAPE OF THE EXPLANT (COMPARED WITH A NORMAL CELL, *d*)

Analysis of factors acting on fibre orientation

The M. neurons have been successfully used for an experimental study of the factors acting on the orientation of the intracentral fibre paths.

It should be remembered that, in order to explain the orientation of fibres both in the intracentral and in the peripheral paths, various authors have considered either mechanical factors, such as the condition of the ground substance, or attractive factors, represented by stimuli of various kinds (mechanical, chemical, biological stimuli), as typical phenomena of tropism. The biological factors considered are essentially represented by the nervous activity of precociously differentiated centers, or developing embryonic organs, the latter

factor being especially taken into consideration in the orientation of the peripheral fibres.

Oppenheimer (1941), basing her conclusions on the behavior of the axons of supernumerary M. cells in *Fundulus* embryos, considered the mechanical forces of no importance, giving on the contrary prominence to the attractive forces exerted by fibres growing caudally, such as those of the medial longitudinal fasciculus. Also the mauthnerian chiasma was explained by this author (1942) as a space-time relationship between the growth of the medial longitudinal fasciculus and the growth of the M. fibres. According to her, the M. axon crosses the midline before the ipsilateral fasciculus reaches this level, but as soon as it reaches the other side, it is attracted caudally by the contralateral fasciculus, which has by this time attained this level. This explanation was not accepted by Piatt (1944), who, after experimentally retarding the growth of the medial longitudinal fasciculus in *Amblystoma* embryos, observed that the M. fibres crossed just the same.

The problem of the specific course of the M. fibres was investigated also by Stefanelli (1947c, d, 1948b) through experiments on embryos of *Rana esculenta*. He considered both aspects, first, that of the decussation, and second, that of the caudal growth on the opposite side. He tried to change or to prevent the normal course of the fibres by means of various operations: (a) removal of contralateral parts supposed to have an attractive action, e.g., the other M. cell and the vestibulo-lateral organ and ganglia; (b) rotation in situ of the neuroblast, in order to reverse its polarity; (c) transplantation, along the presumptive course of the M. fibres, of extraneous nervous tissue, or of other tissue, likely to create an obstacle; (d) transplantation to different places, near or far from the normal position, of the M. cells; (e) transplantation of a mesencephalic portion, normally extraneous to the M. fibres, to a position caudal to the medulla; (f) explants of the M. anlage, in which the course of the fibres was studied in relation to different degrees of regulation.

First of all it was noted, in agreement with observations made by Detwiler (1927a, 1933) on *Amblystoma*, that neither the peripheral organ and the contralateral cell can be considered essential sources of stimuli for the decussation, since the latter occurs also in their absence. In the same way the lack of the homo- and contra-lateral fasciculi, produced by resecting the rhombencephalon anterior to the level of the M. cells, does not prevent normal decussation. This is in accordance with the work of Piatt (1944). The experiments of rotating the neuroblast and of transplanting extraneous tissue to the presumptive course of the fibre are of the first importance elucidating the structural nature of the ground substance and of the tropism shown by the growing fibres. It must be remembered that Weiss (1933, 1934), in opposition to the view of the importance of tropism in the growth of nervous fibres, has given prominence to the structural condition of the ground substance, assuming its submicroscopical orientation. The course of the fibres, according to Weiss, is directed by the structure on which they grow, their orientation being thus acquired passively.

The experiment of rotating the neuroblast 180° gave the first convincing proof of the presence of attractive stimuli, prevailing in the structure of the ground substance. The neurite, which after rotation arises from the external, instead of the internal side of the cell, turns abruptly on itself, reaches the midline and crosses it just as it normally does. It is interesting to note that whereas, at stage 27, the axon shows this reversal of its direction in order to reach its normal connection, the dendrites grow in aberrant directions in the medio-ventral part of the medulla.

Experiments made by Piatt (1944) in which the M. cell was transplanted to a site very distant from its normal location (in the telencephalon) induced him to suppose that no attractive stimulus exists, for the fibres in these cases followed a highly abnormal course, growing tortuously, with sudden changes of direction and atypical branching. But if the M. cell was transplanted to a place near the normal one (Stefanelli, 1947c), then, after wandering in a territory which it normally does not cross, the fibre reaches the normal path. By transplanting two pairs of M. cells to the anterior part of the medulla, Stefanelli obtained, in two cases, four M. cells and four fibres growing parallel along the normal path.

Other experiments by the same author more decisively demonstrate the effect of tropisms in the growth of nervous fibres. Stefanelli transplanted into the presumptive course of the M. fibres a piece of extraneous nervous tissue or a skin fragment, which, by dissolving, caused a structural alteration within the region. When the operation was performed in the region of the

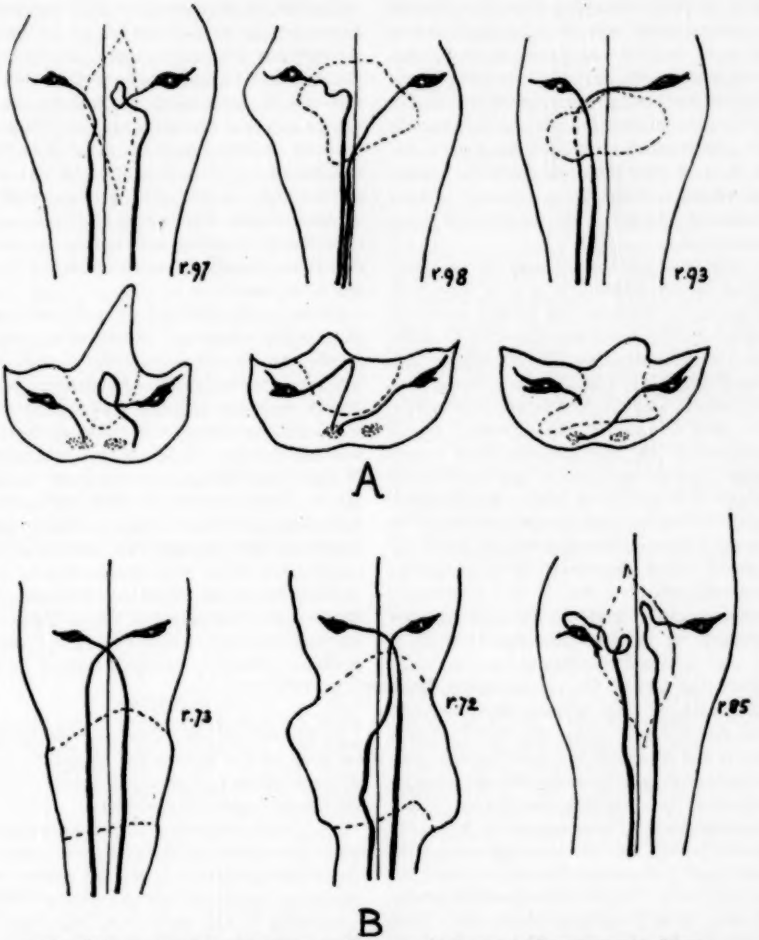

FIG. 9. DIAGRAMS OF THE COURSE OF MAUTHNER'S FIBRES IN EXPERIMENTAL CASES

A. Front and transverse diagram of course of the M. fibres when extraneous nervous tissue is interposed in the midline region (delimited by a dotted line); the longitudinal medial bundle is stippled. In r. 97, crossing inhibited for both neurons; note the wandering aspect of the right fibre. r. 98 and r.93, only the crossing of the fibre shown on the left is prevented. In r.93 the course downwards of the left fibre is outside of the longitudinal medial bundle. B. In r.85 neither fibre crosses; note the behavior of the axon of the rotated M cell on the left. r.73 and r.72, two cases of implanted mesencephalon caudally to the medulla oblongata. The M fibres pass through this abnormal zone directly downwards. In every case the M fibres grow caudally.

mauthnerian chiasma, the M. fibre, which normally grows towards the midline of the ventral raphe, upon reaching the new tissue modified its course as if it were disoriented by the new condition; but after more or less extended wandering, it turned in a caudal direction, while still in foreign territory, and reached the medial longitudinal fasciculus of the same side. The implanted tissue had therefore prevented the decussation, but it had not prevented the attraction of the fibre toward the tail

(Fig. 9). Stefanelli never observed a fibre directed in a reversed polar sense, such as Piatt saw in many cases, but this can be explained by considering that the highly ectopic position of the transplanted cell caused a very extensive wandering of the fibre without its coming under the action of the stimuli which normally make it grow caudally. In some cases Stefanelli could also observe the decussation of the fibre, especially when a discontinuity occurred in the fragment of transplanted tissue.

We may conclude that, though the structural condition of the substratum is very important, some attractive forces are also present, which are strong enough to prevail over the obstacle caused by an extraneous structure. The stimulus attracting the fibre caudally appears to be stronger than the stimulus to decussate, at least considering them at the same moment of development. Also, the experiments of the transplantation of a mesencephalic segment caudally to the medulla are significant. This part of the brain, which M. fibres normally do not traverse, is directly crossed by the fibres of the medial longitudinal fasciculus and by the M. fibres, apparently as if it were no obstacle (Fig. 9b).

From the behavior of the fibres in all these experiments we must presume the existence of some kind of stimulus (chemical, mechanical, or the like) that acts on the growing fibres, which on their part, by their intrinsic nature acquired by the determinative action are capable of perceiving it and reacting to it in a determined sense. This intrinsic potency must be assumed when we consider that the attractive stimulus acting in a rather large zone (cf. experiments in the transplantation of the M. cell to a region near the normal one) produces an effect only on the M. fibres and not on the fibres of other cells present in the same zone. The experiments of Piatt (1944) in which the M. fibres did not connect with the elements of the spinal cord, and the aberrant behavior of the medial longitudinal fasciculus in the experiments performed by Rhine and Windle (1944) are not to be regarded as contrary to the tropism theory, for in these cases the source of the stimulus was too distant (in time and space) or had been destroyed. The structural factors which represent a condition of the first importance in vitro, although present, must be considered of secondary effect in vivo, the predominant role being played by various attractive factors.

Particularly important for the evaluation of factors acting on the orientation and especially the decussation of nerve fibres is the behavior of the M. fibres in small explants taken from one side only of the presumptive medulla oblongata of frog embryos (Stefanelli, 1947c). When these explants regulate themselves so as to produce a rather wide contralateral part, the M. fibre crosses to the morphologically opposite side, though ending there because of limited space. It seems evident that the symmetrical part acts as a sufficient stimulus on the fibres *provided of intrinsic crossing quality* to cross.

In the investigations by Stefanelli the nature of these stimuli was not explored; but Kappers' (1913) concept of neurobiotaxis, being strictly related to an initial nervous activity, does not appear to be an adequate explanation, for the tropistic factors also operate independently of any oriented nervous activity. The results obtained by Stefanelli (1947b, c, d), in which decussation of the M. fibres occurred in small explants which had regulated to form a contralateral part at the expense of the explanted homolateral material, supply clear proof that the decussation is not produced by any functional activities, but by the morphological bilaterality of the substratum, acting on fibres whose intimate functional nature is to connect the two symmetrical parts of the body.

CONCLUSION

In this brief review I have tried to coordinate the work on the M. cells and fibres from various divergent points of view, morphological, ecological, physiological, and embryological.

The peculiar character of these two giant neurons, representing a true functional nervous apparatus in the Ichthyopsida, and related to the swimming activity effected by means of orthotonic movements of the trunk and tail, offers some remarkable advantages for the study of the neuron in its development, morphology, and physiology.

Comparative anatomy has resolved the question of the morphological nature of these neurons, and has demonstrated that they belong to the system of particularly differentiated centers, such as the nucleus motorius tegmenti, of the medulla oblongata. Also the experimental physiological analysis gave definite results, although the interpretation of the experiments is rather difficult, owing both to the technical difficulty of performing a localized operation, and to the various physiological

mechanisms which appear during development and hide the functional value of these elements.

From the physiological point of view, the most convincing results were obtained by morpho-ecological method, based on the morphological comparison of related species having various swimming abilities, due to their different ecology.

From all these researches, which complement each other and may be integrated, it is clear that the mauthnerian apparatus has a multiple function, representing above all a system of connections between certain static centers, particularly those of the lateral line, and the motor centers of the tail muscle which operate in the swimming activity.

The regression of the M. neurons after metamorphosis even in those species, such as *Xenopus*, in which the lateral line does not disappear in the adults, demonstrates that the coexistence of both structures connected by these neurons, namely, the lateral line and the tail muscles, is necessary for the presence and differentiation of the M. neurons.

From a general point of view, the M. neurons have proved to be extremely useful for the investigation of the histogenetic determination and specific differentiation of the neurons, and for the study of the factors acting on this differentiation and on the growth and differentiation of the fibres.

By this study it was possible to reveal two consecutive phases in the process of histogenetic determination (a general and then a particular histogenetic determination). The first imparts to the cells of the neural plate the general character of nervous cells; and the second, the value of particular, highly specific neurons, owing to the activity of local histogenetic fields.

It has also become possible to understand the significance of the intrinsic differentiative potentiality of the neuroblast, and of the extrinsic factors; as well as the effect of the functional activity of the neuron on its structure. Thus it has been possible to trace the vital cycle of the neuron in relation to all these factors.

The study of the orientation of the M. fibres, which can very easily be followed in the sections due to their size, has allowed the evaluation of the forces acting on this orientation along the characteristic nervous paths. It has revealed the factors related to the structural condition of the ground substance and the tropism acting on the growing fibres.

These researches are sufficient to show the importance of the M. cells as a biological material. Judiciously used, they can still throw much light on many biological problems.

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NEW BIOLOGICAL BOOKS

The aim of this department is to give the reader brief indications of the character, the content, and the value of new books in the various fields of Biology. In addition there will occasionally appear one longer critical review of a book of special significance. Authors and publishers of biological books should bear in mind that THE QUARTERLY REVIEW OF BIOLOGY *can notice in this department only such books as come to the office of the editor. The absence of a book, therefore, from the following and subsequent lists only means that we have not received it. All material for notice in this department should be addressed to H. B. Glass, Associate Editor of* THE QUARTERLY REVIEW OF BIOLOGY, *Department of Biology, The Johns Hopkins University, Baltimore 18, Maryland, U. S. A.*

THE LIFE-WORK OF A FOUNDER OF BACTERIOLOGY

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A review of MICROBIOLOGIE DU SOL. *Problèmes et Méthodes. Cinquante Ans de Recherches. By S. Winogradsky. Masson et Cie., Paris.* 3000 fr. 861 pp.; ill. 1949.

The establishment of microbiology as the third great division of biological science was one of the final achievements of European culture in its Golden Age, the nineteenth century. Now, looking back across the intervening fifty years, we possess the necessary perspective to measure more or less definitely the weight and worth of the pioneers who were responsible. Among a host of lesser figures, four men of first magnitude stand out. Towering over them all is Pasteur, clearly visible as one of the great figures of scientific history, whose creative genius laid the foundations and added a good part of the superstructure. Next the eye perceives three figures of somewhat lesser magnitude: Koch, Beijerinck, and Winogradsky. Koch provided a sound methodological basis for the growing science and was responsible, together with Pasteur himself, for establishing the germ theory of disease. Beijerinck and Winogradsky share the honors for revealing the two other great concepts of microbiology: the physiological specificity of different microbial types, and the essential role of microorganisms in maintaining the cycle of matter. These two closely-related concepts had been foreshadowed, it is true, in Pasteur's early researches, but it remained for Beijerinck and Winogradsky to fill them out and give them substance. The problems that confronted Beijerinck and Winogradsky, markedly different from those faced by Koch and by Pasteur in his last period, made necessary the elaboration of a special methodology, whose cornerstone was the technique of selective or enrichment culture. Hence in the realm of method their contribution was almost as great as that of Koch.

With the publication of Winogradsky's collected works, the complete researches of the great quadrumvirate are now accessible. In one remarkable respect, the collected works of Winogradsky differ from those of his compeers. The accident of longevity has allowed him (whose first paper was published in 1887, a bare decade after Koch's scientific debut) to edit his own researches and to provide them with retrospective commentaries written in 1945. For entirely justifiable reasons, Winogradsky has abandoned a strictly chronological order in favor of arrangement into ten major parts, each concerned with one close-knit aspect of his discoveries. These are: The First Autotrophs, The Morphology of Bacteria, Nitrification, Anaerobic Nitrogen Fixation, Retting, The Methods of Soil Microbiology, Cellulose Decomposition, *Azotobacter*, Symbiotic Nitrogen Fixation, and finally, The Principles of Ecological Microbiology. That such a neat and all-inclusive subdivision could be made tells us much about Winogradsky's creative approach, which was so radically different from that of Beijerinck even though their achievements had so much in common. It would be a hopeless venture to try to arrange Beijerinck's works into a small number of neat parcels. His was the extensive, unpremeditated approach of the natural historian. A prodigious worker, armed with superb powers of observation and an insatiable curiosity, Beijerinck wandered at random through the world of microorganisms always ready to follow any promising bypath. By so working, he was able to map a vast territory. Winogradsky's approach, on the other hand, was the intensive, fully conscious one of the exact scientist. It seems not improbable that the main lines of his researches were clearly formulated in his own mind at a very early stage of his scientific development. He

worked over a far smaller area than did Beijerinck, but the problems with which he concerned himself were nearly all of the first importance, and were very deeply probed. Consequently his achievement, viewed as a whole, has a finish and an esthetic perfection that are lacking in the Dutch master's.

External circumstances divided Winogradsky's scientific career into two halves of almost equal length, separated by a long period of inactivity. The first half extended from 1885 to 1906. In the former year, Winogradsky came from his native Russia to the laboratory of the great mycologist de Bary, in Strasburg. There, under de Bary's influence, he carried out his extensive researches on the morphology of sulfur bacteria, a group which had proved unamenable to the methods of pure culture developed by the Koch school, and which had for that reason become the last resting-place for the concept of bacterial pleomorphism in its original nineteenth-century version. Although Winogradsky did not succeed in obtaining pure cultures of these organisms, he worked out ingenious methods for maintaining crude cultures in the laboratory, and was able by painstaking continuous microscopic observation on such material to establish conclusively the constancy of form of these organisms. This work provided the death-blow to pleomorphism in its original manifestation, and thereafter the Cohn-Koch dogma of monomorphism remained unchallenged for many years. Much later, Winogradsky, stung by the reemergence of extravagant pleomorphic concepts, returned to the subject in several critical essays of which "The doctrine of pleomorphism in bacteriology" (1937) provides by far the best and most authoritative historical summary of this long and confused problem.

In order to obtain controllable growth of the sulfur bacteria for his morphological studies, Winogradsky had to examine the problem of their nutritional physiology, and this work led him into uncharted scientific regions where the influence of de Bary is no longer discernible. In the present volume, one can trace the resultant growth of the brilliant concept of chemoautotrophy through the early, tentative studies on the nutrition of sulfur and iron bacteria to its majestic culmination in the researches on nitrification (1889–92), which are undoubtedly the high point of Winogradsky's achievement. There are few pieces of biological research which can compare with the discovery of the nitrifying bacteria for elegance of method, soundness of reasoning, and daring originality of thought. It is a measure of Winogradsky's depth and thoroughness that fifty years were to elapse after the completion of his work on chemoautotrophy before Umbreit and his collaborators, applying new biochemical techniques to the problem, provided the first significant extension of the basic Winogradskian concepts.

As Winogradsky tells us in his introduction, "ce travail m'a valu l'honneur de l'invitation de la part de PASTEUR lui-même, de venir m'établir à l'Institut de son nom édifié à Paris en 1890. A mon grand regret, l'obligation de retourner dans mon pays d'origine . . . m'a empêché d'accepter l'insigne honneur." Returning to Russia in 1891, Winogradsky worked for fifteen years at the Imperial Institute of Experimental Medicine in St. Petersburg. During this period the tempo of his reasearch appears to have been retarded, and apart from some further studies on the nitrifying bacteria, his principal contribution was the discovery of nitrogen fixation by free-living bacteria (1896). Curiously enough, he overlooked the more readily cultivable aerobic nitrogen-fixers of the genus *Azotobacter* (which were discovered some years later by Beijerinck) and established the principle of non-symbiotic nitrogen fixation with a strict anaerobe, *Clostridium pastorianum*.

The first half of Winogradsky's career ended with his retirement in 1906, when he was still a comparatively young man. We are not told the reasons that led to it, nor is it clear whether Winogradsky himself considered it permanent. At all events, it was rudely interrupted by the Russian revolution, which forced him into exile. In 1922 the invitation to join the Pasteur Institute, first extended by Pasteur over 30 years before, was renewed by his successor Roux, and Winogradsky, now at the threshold of old age, once more took up his researches. The letter in which Roux extended this generous and (actuarially speaking) seemingly rash invitation is reproduced in facsimile at the front of the present volume. The outcome was certainly unexpected; the long second half of Winogradsky's career (1922–1945), although not quite as rich as the first, would nevertheless have sufficed in itself to establish a major reputation.

During this period, his attention was principally devoted to the analysis of the microbial ecology of soil by new methods. The nature of the microbial agents responsible for the major steps in the cycle of matter had been previously elucidated, largely by Winogradsky himself and by Beijerinck. Their primary tool had been the accumulative enrichment culture which (particularly in Beijerinck's hands) had been used for the isolation and study of an enormous variety of physiologically-specific microbial groups. This invaluable technique consists of preparing a solution of strictly defined chemical composition, inoculating it with a small amount of soil or water, and incubating it under defined physical conditions (light, temperature, access of O_2, etc). By subsequent examination one can determine (and if need be, isolate) the microflora which comes to the fore as a result of the selective action of the prescribed physico-chemical conditions on the immensely varied population of the original inoculum. The observer thus in effect *controls his ecology*, and can carry

out ecological studies of a precision and refinement that are far beyond the reach of the botanist or zoologist. The technique has an additional usefulness, in that it enables one to obtain with great ease microorganisms possessing well-defined and highly specialized physiological characters, even though these organisms may constitute an infinitesimal fraction of the total natural microbial population.

Nevertheless, as a tool in the study of soil ecology, the accumulative enrichment culture has two drawbacks. Firstly, the use of a liquid medium constitutes a radical departure from the physical conditions that exist in soil. Secondly, in a liquid environment there is a very high degree of selection, so that as a rule only a few of the microbial types potentially capable of developing in a given liquid enrichment medium develop in sufficient numbers to be subsequently isolated. In order to gain a closer insight into microbiological transformations as they actually occur in soil, Winogradsky turned first to direct microscopic examination, extending and refining the methods of such earlier workers as Conn and Rossi, and using this technique to observe the changes that occur when specific chemicals are introduced into the soil. The information obtainable by microscopic analysis, however refined, is highly restricted; for studying the role of specific *physiological* groups in soil, Winogradsky found it necessary to modify the traditional enrichment culture techniques. This he did by turning to *separative* enrichment: the use of a solid medium (silica gel) impregnated with suitable nutrients and inoculated at spaced intervals with small particles of soil. Besides simulating closely the physical conditions in soil, such separative enrichments permitted the development and subsequent isolation of the rarer and more slowly-growing types in a given physiological group, since selection within the group was minimized by the physical separation between soil particles carrying the inoculum. Using this technique of isolation, Winogradsky reinvestigated several important physiological groups, and was able greatly to extend our knowledge of them. His studies on the agents of aerobic cellulose decomposition and on the *Azotobacter* group are the outstanding examples of this line of work. From these and other similar studies, there developed a taxonomic concept of great significance which, perhaps because of the challenging paradoxes that Winogradsky used to express it, has been largely overlooked by microbiologists. This is the concept of the *ecologically-defined* microbial species. The basic arguments that underlie its development are as follows. When studied by the customary pure culture methods, a microorganism is not subjected to the biological competition that exists in nature, and hence may prove capable of developing under conditions which are far from optimal and would lead to its speedy suppression in a competitive environment. In other words, the investigator who works solely with pure cultures is free to *force the species*, by developing its latent or potential characters which in nature never receive more than momentary expression; consequently, a study of pure cultures carried on without due regard for ecological considerations can easily degenerate, without a conscious realization of the fact on the part of the investigator, into a study of physiological and morphological artefacts. This contention of Winogradsky's has been confirmed in recent years by the work on bacterial genetics, which shows how greatly the characters of a species in pure culture can be modified by *conscious* manipulation. There are mutants of even so well-known a species as *Escherichia coli* which could never be taxonomically identified if we were ignorant of their past history. Winogradsky's recognition of such dangers led him to give up the *obligatory* study of bacteria in pure culture, and to work with microorganisms as far as possible in enrichments, at least until he felt confident that he had grasped the salient conditions for their natural development. It is perhaps not surprising that to a generation drilled in the importance of pure culture methods and as yet unaware of the implications of bacterial genetics for taxonomy, Winogradsky's oft-reiterated insistence on working with "dirty cultures" was unintelligible. However, his elaboration of the concept of an ecologically-defined microbial species may well prove one of the cornerstones of future bacterial taxonomy.

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GENERAL BIOLOGY: PHILOSOPHY AND EDUCATION

SCIENCE ET PHILOSOPHIE. *Unité de la Connaissance. By Général Vouillemin. Éditions Albin Michel, Paris.* 130 fr. (paper). 197 pp. 1945.

The author of this book calls his philosophy of science "logical empiricism." Many of his ideas are derived from the so-called Viennese Circle, a group of logical positivists whose views are familiar in the United States today. Vouillemin agrees with Russell and Whitehead that mathematics is a subdivision of logic or "formal science." While formal science tests the validity of arguments or chains of reasoning, empirical science tests the truth of propositions. Vouillemin states that only propositions about measurable relationships can be tested by rigorous experiment. He believes that all empirical sciences have the same presuppositions and methods and that they all have certain limitations. The author regards the space and time of physics not as being empirical data, but rather as being formal constructs which are used to correlate data. Spatio-temporal schemata may be, and have been, modified in the advance of physical science.

According to Vouillemin, the limits of science are the limits neither of meaning nor of reasoning. Our thinking about scientific methods is extra-scientific thinking and there is something in our experience of individuals which transcends scientific formulation. We group individuals under class names because we discover similarities among individuals. Our scientific laws state how individuals of certain classes have co-varied in the past. Science does not deny that each event is unique, despite its similarities to others, and that it is internally dynamic, or even spontaneous, despite its co-variation with others. Vouillemin also points out that the total system of processes, considered as an individual, defies correlational methods altogether, although it may inform our perceptions.

The author tends to favor a strictly mechanistic approach in the science of biology. Experiences of beauty, like experiences of functional fittingness, either in the total system or in subsystems, become causes of a reverence which, in Vouillemin's opinion, has nothing to do with science. In a word, there are different ways of organizing experience, of which the quest for scientific correlations is one, and this way of organizing experience provides no criticism of the other ways. We are poor scientists, however, when we allow the other ways to affect our purely scientific procedures.

ROBERT F. CREEGAN

GREEN THRALDOM: *Essays of a Chinese Biologist. By Tang Pei-Sung; introduction by Joseph Needham. George Allen & Unwin, London.* 12s. 6d. net. 127 pp.; ill. 1949.

This admirable little collection of essays consists of a series of highly readable accounts of a variety of physiological and biochemical topics. *Green Thraldom* refers to our bondage to photosynthesis, and originally appeared in the *Scientific Monthly*, 1944, under the title *Helios and Prometheus—a Philosophy of Agriculture.* There is also a study of the mechanism of silk formation by the silkworm, chosen as a topic of much economic importance to the Chinese, but discussed as an interesting part of the story of protein synthesis in the animal body. The energy relations in the transformation of chemical energy into biological work are frequently emphasized, and are discussed with beautiful clarity, particularly in an essay on muscle, and in another on embryos and energy. Other topics are plant growth hormones, fat metabolism in plants, the machinery of fermentation, and the dietary problems of the Chinese people. Each essay carries a series of references to literature, for the most part Occidental, but generally including some Chinese authors. The volume can be highly recommended as thoroughly sound supplementary reading for students in biology, general physiology and biochemistry, particularly in general orientation courses. There is a relative dearth of material in which there is such a happy blend of unassuming simplicity with a well balanced selection of fundamentals.

Furthermore, the appearance of these essays, under the circumstances in which they were written, makes them a peculiar tribute to the quality of their author and a group of scientists who are working in contemporary China. Tang Pei-Sung, formerly member of the faculty of Harvard University, and now Director of the General Physiology Research Institute of the National Tsing-Hua University, wrote the book during the time of his University's evacuation to the western provinces as a result of the Japanese invasion. In his introduction, Needham says, "in a small village among the mountains not far from Kunming, (under unbelievable difficulties) Tang Pei-Sung created laboratories of general physiology, not ill-equipped, though constructed of mud bricks and woodwork; and above all knew how to surround himself with eager young scientific workers in the true research atmosphere. Here . . . work on plant growth hormones, metabolism in amphibian metamorphosis, electrophysiology of plants and animals, properties of plastics, and the like, proceeded steadily. Nearly all of it had some relation to China's practical problems.

"Like Paracelsus or Comenius in the old unhappy disturbed times in Europe, or like the scholars in the times of confusion when Yuen was giving place to Ming, or Ming to Ching, Tang Pei-Sung has had to lead a wandering life. But it has not spoilt his good humor, nor dimmed his insatiable curiosity about the living cell, nor led him to doubt the social significance of science and the part it should play in freeing humanity from fear and burdens. Smoking a little

pipe, and with head on one side propounding some intriguing problem to one of his young men at Tapuchi, with the Yunnan mountains in the background, so he will remain in my mind's eye, long after he and his have returned to the occupation of bigger and better buildings than those they had to leave to the Japanese."

EVELYN HOWARD

VOM MOLEKÜL ZUR ORGANISMENWELT. *Grundfragen der Modernen Biologie.*

By Ludwig von Bertalanffy. Akademische Verlagsgesellschaft Athenaion, Potsdam. DM 6.60. 126 pp. + 16 plates; text ill. 1949.

DAS BIOLOGISCHE WELTBILD. *Erster Band. Die Stellung des Lebens in Natur und Wissenschaft.*

By Ludwig von Bertalanffy. A. Francke, Bern. S. fr. 11.00 (paper); S. fr. 14.50 (cloth). 202 pp. 1949.

Goethe's prophetic outlook on life and nature has undoubtedly inspired Ludwig v. Bertalanffy's ways of thinking, which in turn have influenced his work as a biologist. While he represents the "universal man" who seeks his answers to our present quests about truth and reality as philosopher and poet as well as scientist and teacher, he does not wish to mix up these various approaches, and so emphasizes the exact and inexorable laws of strict research which the scientific method requires that we follow. The booklet *Vom Molekül zur Organismenwelt* is a condensation of a number of lectures and presents a short survey of explorations into modern biology and its problems with stress upon recent discoveries. Proof is given that modern biology is not a segregated, ingrown branch of natural science but is participating in its own right in fundamental problems of present life. It also contributes significantly to an emerging philosophy which looks at nature as a whole, leading to the author's new conception of "Organismic Interpretation."

The book is divided into 3 chapters: Structure, Processes, and History, with headings on each page and comprehensive illustrations. The student is led from the fundamentals of the chemico-physical world to the questions of structure mechanics, enzymes, growth-regulation, the interplay of forces, the submicroscopic, microscopic, and macroscopic orders. The recent theories of evolution are developed ontogenetically and phylogenetically, including radiation genetics and quantum biology. The reader is introduced to the conception of the "open system" of living matter as a dynamic order, contrasted to the "closed system" of the inanimate world, and to the biological equilibrium for which the author has coined the word "Fliessgleichgewicht," as observed in the metabolism, regulation, and repair of living organisms.

The other book, *Das biologische Weltbild*, is the first volume of a work for which a second is now in preparation. It is of a more technical nature, and is written from the standpoints of science and philosophy simultaneously. Its opening chapter begins with a quotation from Goethe: "The adolescent, when attracted by nature and art, believes—due to his vivid striving—himself to have penetrated into the holy of holies; the adult, however, after having wandered about for a long time, notices finally that he finds himself still in the ante-rooms." During the 19th century, when natural science was still in the adolescent stage, it was naively believed that the fundamental mysteries were all about to be solved, and that the old mechanistic theory of Descartes was sufficient to account for all natural phenomena.

Today we are not so sure. Nature now seems like an ancient Toltec pyramid which must be ascended one step at a time, each step disclosing new phenomena which the old laws, although they still hold, are not sufficient in themselves to explain. The living organism is like a river, a simile which we owe to Heraclitus, and remains the same river even though the water of which it consists is being continuously replaced. From the standpoint of physics and chemistry the living body is identical with the atoms of which it is composed, and will continue to be so after it has ceased to live and its composing particles have been disseminated throughout the universe. But from the standpoint of biology the living body has a meaning quite apart from that of its component particles, and unlike the figures in Euclid's constructions it is a Whole greater than the sum of its parts; it has personality, memory, and (in the case of man) conscience, which do not inhere in its physical substance. The mechanistic theory, so von Bertelanffy thinks, is quite incompetent to account for these; for, like Mephistopheles in Goethe's poem, it is the spirit that denies. But the alternative vitalistic theory is not much better, because it is not scientific. It occupies an anomalous position between science and poetry, and for every question it answers it asks a new one. A new theory is needed, one which will not refute either mechanism or vitalism but will transcend both in a new approach. Such a theory is promised in the coming volume, which will be awaited with excitement and anticipation.

BIOMORPHOLOGY IN GENERAL. *Verh. Kon. Nederland. Akad. Wetensch., Afd. Natuurkunde. Tweede Sectie, Deel XLVI, No. 1.*

By J. C. Schoute. North-Holland Publishing Co., Amsterdam. F. 4.50 (paper). 93 pp.; ill. 1949.

In the last half century morphology has moved from a position of dominance among the biological sciences to a position in which it receives much less attention than the currently dominant disciplines of genetics and

physiology. This does not indicate any lessening of the importance of morphology, but probably a realization by many investigators that any rational approach to morphological problems necessitates much more understanding of inheritance and the physiology of development than we now possess. *Biomorphology in General* is a fragment consisting of the first 2 chapters of a book in which Schoute intended to present a comprehensive picture of the morphology of mature organic forms, the development of these morphologies, and their causal bases. The material was edited by R. Van Der Wijk, one of Schoute's students. The lapse of some 7 years between Schoute's death in 1942 and the appearance of the work is unfortunate, for there have been important developments in morphogenetic research in the interim. The fragment includes what to Schoute represented the general principles of biomorphology, and an analysis of organic symmetry.

The key question in any approach to morphology as a dynamic science is whether the morphology of an organism is simply the end result of a series of complexly interrelated biophysical and biochemical processes or whether in some manner, not yet made clear by research endeavors, elements of the morphological pattern have an existence in fact and exert a controlling or directing influence upon the extent or the interrelations of at least some of the biophysical and biochemical processes. The first view is subscribed to by most of the exponents of the biochemical approach to the functioning of organisms, and it assumes that, in a sense, form has no validity except as an interpretation of functional relationships. The second view has been stated in recent times by many fewer investigators, partly one suspects because of the greater difficulties in stating it intelligently and in collecting valid evidence to support it. Schoute's last work begins with a statement that the physiological processes afford the only field for "causal analysis" of biomorphology, but it moves rapidly into a presentation of symmetry by the classical methods of mathematical and geometrical interpretation, modified, to be sure, in the light of many pertinent observations made by the author. The progress of the first 2 chapters of *Biomorphology in General*, from its contention that the approach to morphological problems must be via developmental physiology to its more classical and more static analyses of symmetry, is inevitable in the present state of our knowledge; indeed, is indicative of this state. We simply do not yet have sufficient knowledge of the developmental processes which underlie the unfolding of form in organisms to interpret mature morphology in terms of developmental physiology. This is the goal toward which the efforts of investigators interested in growth and development are aimed. As a statement of the nature of the problems involved in gaining an understanding of morphology, Schoute's fragment is significant. For its reinterpretation of certain aspects of symmetry in organisms it is of considerable interest. In its own progress from the clear-cut statement of the ideal to a concern with the arguments of interpretation of mature symmetry forms, it gives clear indication of the inadequacy of our knowledge of the developmental bases of morphology.

W. GORDON WHALEY

BIOLOGY. *Revised Edition.*

By Brother H. Charles (Charles F. Severin). Bruce Publishing Co., Milwaukee. $2.96. x + 522 pp.; ill. 1948.

This is a textbook intended for high school students, particularly in Roman Catholic schools. Except for a few references to God as the Creator, the book differs in no way from similar textbooks. It might be maintained that biology should be taught without religious implications. However, to assume the activity of a Creator is no more out of place in a textbook of biology than to defend a mechanistic interpretation of the origin of life, since biology as such offers evidence neither for nor against creation.

The book is attractively printed, and the illustrations are good. The text could be better organized, for greater coherence and clarity of expression. Each chapter ends with a series of review questions and a list of new words. In addition, there are numerous suggestions for project work, lists of books for supplementary reading, and an extensive glossary.

WALTER H. BELDA

THE BIOLOGICAL WORLD.

By Reverend Charles J. Wideman, S.J., and Sister Raphaelis Gehlen, S.C.C.; drawings by Ernest King. Loyola University Press, Chicago. $3.16. viii + 696 pp. 1949.

Like *Biology*, by Brother Charles, reviewed in this issue, this is a textbook intended primarily for Roman Catholic high schools. So far as the religious point of view is concerned, the comments made in the review of the former book apply equally to the present textbook.

This volume has a most attractive format. The book reflects a careful attempt to meet the educational needs of high school students. The text is incisively written, consisting of short, precise sentences rather than of general statements. The book is profusely illustrated, with both photographs and diagrams. The photographic illustrations are dramatic, well chosen, and superbly reproduced. The diagrams, however, are somewhat crudely drawn and labeled. Errors are few. One photograph of what are obviously Canada geese bears the caption: Mallard ducks in flight. Not all would agree with the senior author's statement that Galileo constructed the first simple microscope.

Each unit in the book is followed by a set of review

questions, a vocabularly of new words, directions for laboratory work, directions for project work, and a series of questions for discussion. The extensive appendix includes a scheme of classification of plants and animals, a biographical index, and a lengthy glossary.

WALTER H. BELDA

BIOLOGY FOR ALL. *Everyday Handbook Series.* *By Abraham B. Perkel and Morriss H. Needleman.* *Barnes & Noble, New York.* $1.00. viii + 143 pp. 1950.

This is No. 231 in the Everyday Handbook Series of pocket-sized, paper-bound pulps for the beginner or the curious. It starts out nobly enough with a strong plea for conservation, for understanding of interrelationships among animals, plants, soil, and weather conditions. Then come spectacular overstatements; e.g., "Plants Have Intelligence." The Edwards and the Kallikaks take a bow full of the uncritical commentary prevalent several decades ago. Human anatomy and physiology, with strong emphasis on the nature of disease and modes for combating it, on the endocrine glands, genetics and evolution, crowd the second half of the volume.

LORUS J. & MARGERY J. MILNE

BIOLOGY: HISTORY AND BIOGRAPHY

SCIENTISTS AND AMATEURS. *A History of the Royal Society.* *By Dorothy Stimson. Henry Schuman, New York.* $4.00. xvi + 270 pp. + 17 plates. 1948.

Dorothy Stimson has been investigating the history of the Royal Society of London for some years, and has brought together many of the results of her studies in this book, which is addressed, like the other volumes in the *Life of Science Library*, to the non-scientific reader who wishes to obtain an understanding of science.

Many of the previously published volumes in the series have received enthusiastic reviews. Miss Stimson is a scholar of reputation, who writes as well as many scientists, and her book is clearly as good as many of the others which go to make up the *Life of Science Library*. It would therefore be somewhat unfair, both to the author and her book, to subject it to exhaustive criticism, pointing out possible deficiencies either in content or in method of "popular" exposition. The reviewer prefers instead, therefore, to raise some questions that seem timely in connection with more general problems relating to the popularization of science.

Precisely the important point about Miss Stimson's book and many of these others is that they seem to represent variations of a currently fashionable type. It is the nature of the type which raises grave doubts as to the adequacy of the methods by which we are at present attempting to address our popularizations of science to the lay reader.

It is clear that there is demand for such popularization. It is attested by the continuous "reporting" of scientific "news" in the daily press, by the frequent publication of articles on science in *Life*, *Reader's Digest*, and many other such magazines of wide circulation, by the inclusion of talks on science during the intermissions of the Sunday afternoon Philharmonic broadcasts not so long ago, and indeed by what seems a gradual increase in the number of books which eminent professional scientists are addressing to the lay public.

The question arises as to what degree the latter books satisfy the demand. Their financial profits seem for the most part not to have been quite overwhelming, and that makes it seem that the books themselves still leave something to be desired.

It is merely obvious to suggest that one reason they fall short of their aims might be that they are written by the wrong persons. The situation is not so simple. The *Life of Science Library* appears over the colophon of a courageous and progressive publisher who works with a distinguished Advisory Board and who has chosen as his authors investigators who have expert authority in their own fields, and many of them high intellectual standing.

The fault lies rather perhaps in the attitude of the writer, in so far as this can be separated from his person, toward his audience. Surely the demand for more knowledge of science arises out of man's natural curiosity about the Universe around him and out of his wonder at the intricacies of its operations. It is specifically to this quality of wonder that the present volumes do least justice. They tend, perhaps in their fear of sensationalism, to stodginess and pedantry rather than to vigor and brilliance. What distinguishes them principally is their lack of distinction. They describe as ordinary what surely should be extraordinary, thus making deadly the material in which they purport to interest the reader, not only defeating their own immediate purposes, but actually giving a totally false impression of the method of the working scientist, who most often pursues his own particular project for no other reason than that this happens to be for him the most absorbing and fascinating problem in the world.

Is this a necessary price to pay for simplifying scientific data to the extent that the uninitiate can grasp them? No, too many other authors have succeeded where these have failed. T. H. Huxley has done so, in his lectures to the working-men, Homer Smith in *Kamongo*, Karl von Frisch in *Du und das Leben*, A. S.

Eddington in *The Nature of the Physical World*. George Sarton has done it, in fact, in the volume providing the keynote to the present series. Why their greater success? True, these are or were felicitous writers with a gifted ability to handle language. More than that, they share an optimism which too many pedestrian imitators have lacked. The latter feels that he must condescend when he teaches, and this is the clue. He feels that to simplify is to level down, and it is here that the loss occurs. When the exceptional ones speak, they do not admit that dullness is an inevitable cost of reliability. They choose instead to challenge and provoke that spirit of curiosity which first attracted the reader. They can, because they have greater confidence not only in the reader's desire, but also in his power, to learn.

The ruling spirit of democratic education is its abiding faith in the ability of each individual to develop to the top of his capacity. A scientist runs into the danger of betraying that faith when, by telling his story dispiritedly to an audience he views without sufficient optimism, he presents his material to the nonscientist in such a way as to stifle rather than to excite that natural wonder which is the heritage of us all.

JANE OPPENHEIMER

THE TRAVELS OF WILLIAM BARTRAM. *Edited by Mark Van Doren. Dover Publications, New York.* $3.75. 414 pp. 1928.

This famous volume of the natural history of the southeastern United States needs no introduction to American biologists. It is once more available in an unabridged and inexpensive edition.

I DE CANDOLLE (*Botanici*). *Scienziati e Tecnici. By Raffaele Ciferri. "La Scuola" Editrice, Brescia, Italy.* L.150.00 (paper). 127 pp. + 4 plates. 1949.

In this pocket-sized book, the author presents a comprehensive view of the 5 botanically-inclined members of the De Candolle family. It is formally subdivided into 3 parts, 63 pages being devoted to their lives, environment, and general activities, 40 pages to their scientific contributions, and 8 pages to conclusions regarding the impact of their work on botanical science.

In Part I, both Agostino-Piramo and his son, Alfonso, are considered in detail, the discussion taking in their education, travels, and other activites, academic positions, relations with contemporary biologists, general philosophical approach toward academic problems, and contributions to botany. Casimiro, the son of Alfonso, and his two sons, Agostino and Luciano, are considered briefly, but from the same point of view. Part II is particularly devoted to the family's scientific contributions and their biological significance. Among other things the author calls attention to Agostino-Piramo's methodology and general approach to plant science, his major works, and his attempt to create a more natural system of classification. Alfonso, considered as a versatile and cultured genius with an inordinate capacity for persistent application, is discussed in the light of his contributions to phytogeography and systematics, and his speculations on the origin and distribution of plants and the species concept. Casimiro is regarded as a specialist, most of his work having been pure systematics (monographs of various plant families, etc.), although studies of other phenomena (e.g., phyllotaxy) were also pursued by him and are discussed briefly. Finally, Agostino is given honorable mention (his work on parthenogenesis is noted tersely). Having published his first paper relatively late in life (at 33 years of age), his publications were few.

The author deserves credit for having assembled many pertinent and valuable details about this illustrious family. His book suffers, perhaps, from two weaknesses. First, the author occasionally fails to provide sufficiently critical or extensive evaluations of their works. To illustrate: a more thorough analysis of A. Piramo's *Teoria Elementare di Botanica*, probably one of his finest contributions, might have been desirable; on the other hand, in his enthusiasm, the author may have attached undue importance to the overall contributions of the De Candolles to botanical science. Secondly, the book suffers, in part, from inadequate organization and excessive repetition. In one small section, for example, consideration is given successively to Agostino-Piramo's history, death, political affiliations, scientific contributions, politics again, etc. Furthermore, the most serious objection in the reviewer's opinion is the *inordinate amount* of factual matter and commentaries set forth in Part I and repeated in Part II.

EDWARD C. CANTINO

QUELQUES BOTANISTES BELGES. *Collection Nationale, Ser. 9—No. 95. By René Geerlette. Office de Publicité, Bruxelles.* 35 fr. (paper). 84 pp. + 1 plate. 1949.

Very brief biographical sketches of six 19th and early 20th century Belgian botanists, Francois Crépin (1830–1903), Élie Marchal (1939–1923), Jean Chalon (1946–1921), Théophile Durand (1855–1912), Auguste Gravis (1857–1937), Émile Laurent (1861–1904), and Charles Bommer (1866–1938). In addition there are short accounts of the explorations and botanical collecting trips of Jean Massart. The biographies are all constructed on the same clear and simple plan. First are given the actual details, such as date and place of birth and death, parentage, positions held, and events of interest or importance. There is next a short ac-

count of botanical accomplishments, then a bibliography of important contributions, and finally a list of references from which the data were obtained. The biographies are factual rather than critical, and the collection is essentially a convenient reference source for material on the lives of botanists of medium importance.

CONWAY ZIRKLE

ABBÉ DAVID'S DIARY, *Being an Account of the French Naturalist's Journeys and Observations in China in the Years 1866 to 1869.*

Translated and edited by Helen M. Fox. Harvard University Press, Cambridge. $5.00. xxxii + 302 pp. + 16 plates. 1949.

This book is beautiful in every way—beautifully bound and printed beautifully and appropriately illustrated with drawings of the birds and mammals Père David discovered or with the paintings of Chinese artist-lovers of nature; and beautifully written, in vivid yet unpretentious language, like the character of the intrepid but unassuming, gentle priest who did so much to acquaint the world with the plants and animals of China and Mongolia. Who among zoologists has not heard of Père David's deer, which like the gingko would have become extinct had it not been for the care of the Chinese to preserve it? Far fewer are aware that it was also David who discovered, in far western Sikang, the "white bear," the giant panda that is now such a universal favorite among zoo-goers; or the gorgeous green pheasant of Muping (*Lophophorus ihuysii*); or the monkey with the turned-up nose (*Rhinopithecus roxellanae*), thought to be a creature of the Chinese artists' imagination until Père David had secured it. Perhaps what staggers a modern biologist most in reading such an account as this is the well-nigh complete familiarity with all divisions of the plant and animal kingdoms a great field naturalist of the 19th century could display. Here was no present-day specialist but a man who knew the mammals as he knew the insects, and the birds as he knew the trees and flowering plants. This indeed bewilders the modern reader of these diaries. Just as one would like to have found a good map or two of the regions Père David traversed, so too one would like more pictures and characterizations of the species the naturalist often alludes to so casually. The lack of an index is a serious defect in a book which its readers will certainly wish to consult on many occasions.

BENTLEY GLASS

A CENTURY OF ENTOMOLOGY IN THE PACIFIC NORTHWEST.

By Melville H. Hatch. University of Washington Press, Seattle. $1.50. viii + 43 pp. + 9 plates. 1949.

The author presents a detailed chronology of men and events since John Kirk Townsend first collected insects in the lower Columbia River country in 1834–1836. The more important books, papers, and collections are listed. The entomologist will find this a very useful document, but the student of the history of science will feel that the author has written with too much restraint in not presenting the fuller and more ramified picture of the entomologist in the Pacific Northwest. Included are a bibliography of 249 items, a taxonomic index referring to the more important papers of the bibliography, and a name index, but there is no subject index.

M. C. SHELESNYAK

THE LIFE OF WILLIAM T. DAVIS.

By Mabel Abbott. Cornell University Press, Ithaca, N. Y. $3.50. xv + 321 pp.; ill. 1949.

This is a warm and gentle chronicle of a field naturalist who combined the best traditions of Staten Island with wide curiosity and an honest interest in scientific advance. To many, "Bugs Davis" was queer but likeable. To others he was the "Cicada Man" who specialized on these insects with long life histories. In spite of poor health, compensated to some degree by inherited wealth, William T. Davis filled the years from 1862 to 1945 with detailed observations of living animals and plants, with lending a helping hand to trees or people, with encouraging and being beloved by the biologists of the New York region. In this rewarding life he claimed aspirations to be a tramp; as a result he used his years of "retirement" fully, taking every opportunity to learn more and record his findings where they would be helpful to others. The list of his published papers, included in the book, gives scant suggestion of his meager schooling or the fact that he "could always find two or three ways to spell a word." He had attended "the College of the Field" and made up in accuracy and enthusiasm what he may have missed in formal education. The foreword is by his friend, Edwin Way Teale. The index is full, and like the body of the book, records the happy relationships between Davis and a host of other prominent men of science.

LORUS J. & MARGERY J. MILNE

A NORTH CAROLINA NATURALIST: H. H. BRIMLEY. *Selections from His Writings.*

Edited by Eugene P. Odum. University of North Carolina Press, Chapel Hill. $3.50. xvi + 205 pp. + 19 plates; text ill. 1949.

H. H. Brimley was one of those old-time naturalists who made taxidermy a stepping stone to better things. He earned a reputation as an ornithologist and devoted much of his time to making the North Carolina State Museum a leading educational institution in his adopted state. In this collection of various articles are samples of his writing about birds, museum work, whales and sharks, and so on. It is plain, honest writing, in which the facts or the story come first. Now and then he wrote some verse, but the samples included come off second best beside the prose These selections not only serve as a memorial of their author, but are also interesting for their historical information about the conservation movement and the development of the North Carolina Museum.

JOEL W. HEDGPETH

MEDICINE THROUGHOUT ANTIQUITY.

By Benjamin Lee Gordon; foreword by Max Neuburger. F. A. Davis Co., Philadelphia. $6.00. xviii + 818 pp.; ill. 1949.

In the preparation of this volume Gordon distinguishes three periods in ancient medicine. The first, or prehistoric period, begins with the very birth of man, and information concerning it is deduced from studies of prehistoric art found in caves, of stone instrumentation, and from pathological evidence found in human fossils. This period ends, of course, when history began to be recorded. The second, or protohistoric period, continues until the beginning of the Ionic philosophical school, and the nature of medical practice during this period is derived from such sources as the Old Testament, the Iliad, the Code of Hammurabi, the Egyptian papyri, and Babylonian medical tablets. The third period begins about 600 B.C., or with the Ionian philosophers, and ends with the fall of Rome. This last period is probably best known, since from its start medical knowledge was recorded.

This entire book may be considered a distinct contribution to the library of medical history. Furthermore, it combines enjoyable readability and critical scholarship. The chapters on Talmudic Medicine, Ancient Hebrew Medicine, Medical Concepts in China and Japan, Medicine in Assyro-Babylonia, and in Ancient Egypt are especially worthy of mention. This volume the reader can open to any page at random and be assured of pleasant, informative reading matter.

DAVID B. TYLER

TUBERCULOSIS IN HISTORY. *From the 17th Century to Our Own Times.*

By S. Lyle Cummins; with an introduction by Sir Arthur Salusbury Macnalty. Williams and Wilkins Co., Baltimore. $4.50. xiv + 205 pp. + 12 plates. 1949.

The creditable and aptly accomplished purpose of this reverentially conceived and well-written volume is a documentary account of scientific contributions made by early pioneer workers in the prolonged struggle for conquest of one of the major scourges of mankind, tuberculosis. By steering clear of both historiographic dogmatism and a trifling anecdotal style of reporting, the author succeeds in giving an inspired although impartial appraisal of the memorable discoveries of older phthisiologists as well as of the magnitude of the task to which these men devoted and sometimes sacrificed their lives.

In the first part of the book, which presents the stories of 9 outstanding members of the British School, from Bennet (1617–1655) to Budd (1811–1880), Benjamin Marten is acclaimed as the earliest enunciator of the "germ theory" of tuberculosis, and James Carson as the first performer of an artificial pneumothorax. The second part is devoted to the work of 7 representative leaders among the early continental phthisiologists, including the discoverers of the stethoscope (Laënnec), of mediate percussion (Piorry), and of the inoculability of the disease (Villemin and Burdon-Sanderson). The third part, although purposefully omitting most of the "moderns," brings the account sufficiently up to date with the fascinating tales of "Edward Trudeau's gallant and successful fight against the disease and of the glorious achievements of Robert Koch in discovering and isolating the germ." Commendable for the general professional reader as well as for the medical historian and the specialist in tuberculosis, this interesting volume traces the successive stages which have led to our present knowledge of "a definite though redoubtable enemy."

FRANZ J. KALLMANN

THE FIRST ANESTHETIC. *The Story of Crawford Long. By Frank Kells Boland. University of Georgia Press, Athens, Georgia.* $3.00. xvi + 160 pp. + 16 plates. 1950.

The discovery of surgical anesthesia by Crawford W. Long ever stimulates interest and enthusiasm among those interested in the history of medicine. Boland has written the events relating to the discovery of the use of ether by Long in a sprightly style that captivates the imagination of the reader. One is introduced into the childhood and family life of Long. The author has made the southern atmosphere of pre-bellum Georgia live in the minds of the readers. The strange and acrimonious controversy which developed between Long and the dentist, William T. G. Morton, is discussed from various angles, and evidence is brought forth to reaffirm the fact that Long administered ether as an anesthetic prior to Morton's administration in the

Massachusetts General Hospital. The book is replete with original letters from the friends of Dr. Long and his patients. Amusing is a copy of a bill from Long to a Mr. James Venable for the administration of sulphuric ether, for 25 cents. There are numerous interesting photographs of the scenes and the characters in the dramatic discovery of anesthetic ether. The reader will find this book well written and authentic. It will certainly hold the interest of anyone who is interested in the history of medicine.

JOHN C. KRANTZ, JR.

ECOLOGY AND NATURAL HISTORY

HUNTING AMERICAN LIONS.

By Frank C. Hibben; illustrated by Paul Bransom. University of New Mexico Press, Albuquerque. $4.50. 225 pp. + 4 plates. 1948.

The cover states that this book is the result of a commission received by the author from the Southwestern Conservation League for the purpose of finding out all he could about the habits of the mountain lion. Conservationists will be disappointed in the product of the author's work, at least as far as it is represented in this book, for they will find little new added to our knowledge regarding the habits of mountain lions. It is to be regretted that this is the case, for the relations of this animal to its normal prey should be much better understood before it is hunted any further toward extinction in the name of "conservation."

Instead of a book useful to the conservationist, Hibben has produced a series of hunting stores that may someday be of historical interest, but which tell little about lions beyond the ways in which they react when hunted. It should be noted in closing, however, that these stories are well written and the book can be recommended to the sportsman, if not to the more serious student, with the hope that it will at least arouse his interest in perpetuating the mountain lion as a game animal, if for no other reason.

JOHN CUSHING

JACK MINER AND THE BIRDS. *New England Memorial Edition. Fifth Printing.*

By Jack Miner. Reilly & Lee Co., Chicago. $3.50. xii + 302 pp. + 2 plates; text ill. 1923.

Anyone who has heard of Jack Miner will appreciate this account of his life; anyone who hasn't, should read this book in order to become familiar with a most remarkable man. Jack Miner, by his own account, was an untutored country boy who grew up to become a renowned hunter and outdoor enthusiast. At first he was strictly a gunner or market hunter but growing weary of his slaughtering, he began a duck and goose refuge on his property which has now become internationally famous. Not only did he provide food and shelter for the migratory waterfowl but he initiated a banding program of his own by wrapping metal bands around the legs of the birds. These bands bore the inscription, "Write Box 48, Kingsville, Ontario." On the inner side, Miner stamped quotations from the Bible, thus spreading the Gospel from Arctic Canada to the southern U. S. These inscriptions aroused so much curiosity on the part of the finder that a high percentage of returns resulted. Considering the fact that this man made his entire refuge, made all the bands, stamped them, carried on his correspondence, paid for the high food bill, lectured on conservation, in addition to the duties of his livelihood, it is no wonder that he had a personality that attracted all those who came to know him.

These activities are described in Miner's own words. His style is simple, vivid, amusing, though often repetitious; enthusiasm breathes from every page. Incidentally, this memorial number is a reprint of an earlier successful edition with the addition of several chapters on experiences that occurred during the 10-year interval. It is profusely illustrated with views of the sanctuary and its inhabitants and some maps showing the geographical location of his recoveries. It must be pointed out, however, that Jack Miner was not a trained scientific observer nor imbued with the philosophy of objectivity. He was never afraid to express his opinions and these are told and retold in dogmatic fashion. Some of them are excellent, especially his views on conservation and sportsmanship, others would bear verification. His hatred of birds of prey, even the lowly shrike, causes him to bend backwards in his denunciations. Ofttimes his intimate knowledge of birds caused subjective interpretations of their behavior. If the reader can sift out some of this material there still remains much useful information on the habits of the ducks and geese. Letters from correspondents who recovered banded birds are amusing and often instructive, especially those from the northernmost areas. Ornithologists and sportsmen are indebted to Jack Miner and they are thankful that this personal record is available.

HENRI C. SEIBERT

AGE, RATE OF GROWTH, AND GENERAL LIFE-HISTORY OF THE AUSTRALIAN PILCHARD (SARDINOPS NEOPILCHARDUS) IN NEW SOUTH WALES WATERS. *Bulletin 242, Commonwealth Scientific and Industrial Research Organization, Australia.*

By M. Blackburn. Commonwealth Scientific and Industrial Research Organization, Melbourne, Australia. Paper. 86 pp. + 8 plates; text ill. 1949.

MEASURES OF ABUNDANCE OF PELAGIC FISH *in Some South-Eastern Australian Waters. Bulletin 251, Com-*

monwealth Scientific and Industrial Research Organization, Australia.

By M. Blackburn and J. A. Tubb. Commonwealth Scientific and Industrial Research Organization, Melbourne, Australia. Paper. 74 pp. + 2 plates; text ill. 1950.

SURVEY OF THE COLUMBIA RIVER AND ITS TRIBUTARIES —PART V. *Special Scientific Report: Fisheries No. 38. By Reed S. Nielson. United States Department of the Interior, Fish and Wildlife Service, Washington, D. C.* Paper. 41 pp.; ill. 1950.

CITY OF THE BEES. *Second Edition.*

By Frank S. Stuart. Whittlesey House, McGraw-Hill Book Co., New York. $3.00. x + 243 pp. 1949.

City of the Bees is an imaginative fantasy depicting the various vicissitudes that affect a colony of bees living in an oak tree during an entire year. The author draws on a fertile imagination and considerable experience in bee behavior to give a vivid description of how bees live under natural conditions and how they respond to the diverse forces of nature. Their ability to take care of themselves under adverse circumstances is ably portrayed by a great wealth of descriptive terms. Stuart attributes to bees certain imaginative abilities which tend to add mystery and romance to his description of their mode of living. One who is inexperienced in the way of bees may have some difficulty in separating facts from fantasies. The attribution of certain supernatural powers to the queen and to her control over the colony is offset by a careful explanation of the inherited instincts of the highly socialized insect state.

J. E. ECKERT

LA VIE DES ABEILLES SOLITAIRES. *Histoires Naturelles—9. By Robert Hardouin; edited by Jean Rostand. Gallimard, Paris.* 370 fr. (paper). 269 pp. + 8 plates; text ill. 1948.

The author of this handy volume is an archeologist and painter specializing in the Roman ruins of the Provence, where Fabre, his "dear demi-God," studied insects before him. "Cerceris comes and goes among the Roman steles; Scolia hums under a portico. From ruin to ruin I have descended the valley of the Rhone . . . where the architectural genius of the powerful Romans gave place to the winged hordes which also work in cement." The 268 pages of the book represent the work of 30 years. In the text 150 species are cited; personal observations have been made of many of these, though it is difficult for the reader to determine which facts were ascertained at first hand, and which have been filled in from other authors. The facts of meloid life history and the intricacies of stylopization are, perforce, taken from the literature. Frank quotations, of course, abound for the sake of filling in life histories.

The book begins with a chapter on correlation of structure and function. Throughout the book much attention is given to the bees' mandibles, an attempt being made to correlate their shape and sculpturing with the "profession" of the species, whether "paper-hanger" (leaf cutter), mason, wool-carder, mattress-maker, resin-worker, carpenter, or digger. The correlation does not work out strictly, since some species follow two professions, the same mandibles sufficing for work with two very different materials: plant pubescence, and mud or rosin, for example.

The author was successful in attracting many bees to his "apiary," which consisted of a box holding innumerable bamboo and glass tubes; but the text is not clear just what he learned from these, perhaps because he wished the story to swing along smoothly as indeed it does.

There are full accounts of parasites appended to each chapter; and, so far as the reviewer knows, the author has surpassed all other writers on solitary bees in his list of flowers preferred by each species—which gives more occasion for the lyricism of the writing. There is, however, a very practical chapter on the ecological value of the bees.

An important feature of the book is the author's constant emphasis on the adaptability of all individuals, the "elasticity" and "plasticity" of behavior, and the variability of habits within each species. In this he takes sharp issue with the hero of his youth, Jean Fabre, as did the Peckhams, as well as the reviewer, nearly fifty years ago. But the author frequently relinquishes a desirable objectivity by his simple assumption of "intelligent" behavior on the part of the bees.

Like Fabre, Hardouin goes into ecstacy about the wonderful time he is having in seeing the secrets of his microcosm unfold themselves as he observes, and he succumbs to the usual anthropomorphism at the slightest provocation, for his bee heroines readily become people. His brilliant *Megachile*, for example, chooses a tube already hollowed out in order "to save time," for she "realizes" that she must finish her tasks before autumn and death overtake her. However, before the end of the season many of his "friends" go berserk, behaving most erratically: "After such acts my disappointment is as great as my admiration had previously been high." We may, however, charitably accept such passages as designed to impart a literary flavor to the book.

The problem of sex control has interested this author like so many before him. *Osmia* lays a "female" egg in the large cell which is provisioned with 800 mg. of bee-bread, but a male egg on a 400 mg. mass in a small cell. If one interchanges the eggs, one raises a diminutive female and a large male, which proves that sex is determined at oviposition. In *Anthidium* the male

is much the larger, although in other species there is no sexual dimorphism. The author's "Where? How? Why?" of sex control he does not answer.

For the evolutionist the author points out species which are transitional in both morphology and habits, and he philosophizes as to the origin of inquilines from "productive" species; but, as with other basic problems, he ends with generalities. The numerous illustrations by the author are excellent. A translation into English should prove useful.

CARL HARTMAN

THE NATURAL HISTORY OF SELBORNE.

By Gilbert White. Edited and with an introduction by James Fisher; illustrated by Claire Oldham. Cresset Press, London. $2.00. xxiv + 296 pp.; ill. 1947.

The Tenth International Ornithological Congress, held recently in Sweden and including excursions to the two homes of Linnaeus, makes this recent edition of Gilbert White's classic particularly timely, for White was a contemporary and admirer of Linnaeus, and it was by his discussions of this in his letters to the distinguished zoologists Pennant and Barrington that his familiarity with the ecology of birds and other animals was emphasized. However, the present volume is not just one more edition among the 150 that started 150 years ago, but instead is a modern presentation of Gilbert White's letters. The book is edited by the naturalist James Fisher, an outstanding authority on Selborne, whose introduction discusses very completely "White, the man, the naturalist, and the writer." In addition to the 110 familiar letters, the edition includes White's poems, two dozen wood engravings sympathetically presented by Claire Oldham, an appendix, and full notes, plus an index and glossary of the vertebrate wild animals mentioned.

LORUS J. & MARGERY MILNE

IN WOODS AND FIELDS.

By Margaret Waring Buck. Abingdon-Cokesbury Press, New York and Nashville. $3.00 (cloth); $1.75 (paper). 96 pp.; ill. 1950.

If the reactions of my 8-year-old son to this book are in any way indicative of the appeal which it will have for the curious youngster and budding naturalist, Margaret Buck can be said to have scored a success. He has found it a treasure-trove of interesting things which he himself can observe in his daily wanderings to and from school. Enough of the familiar is discussed and illustrated to provide the satisfaction which comes with first-hand acquaintance, while at the same time a sufficient amount of the less familiar is incorporated to stimulate and challenge.

The book is lithographed. The subject matter, which takes in all of the more commonly found plants and animals, is divided into those things most readily observed during the four seasons; and under the seasons, further subdivision lists the plants and animals according to habitat: fields, woods, and streams. Each organism and its activities are briefly but accurately described, and each is illustrated by black and white drawings. The book will not, unfortunately, replace the comics, but it should assist in counteracting their influence.

C. P. SWANSON

PARTNERS WITH NATURE.

By Isak Green. International Textbook Co., Scranton. $1.75. x + 112 pp.; ill. 1950.

This is an attempt to bring the meaning of conservation to the younger people of this country. The author approaches his topic by considering the cyclical balance that exists in nature, taking into consideration the roles of all organisms, from bacteria to higher plants and animals, in maintaining it. It is a well conceived and integrated book which should appeal to, and stimulate, a young audience at a time when conservation is an obvious necessity. Nature, as an entity, is overpersonalized by the author, but as a teaching device, such an approach is excusable.

C. P. SWANSON

MOOSE COUNTRY. *A Boy Naturalist in an Ancient Forest.*

By Sam Campbell; illustrated by Bob Meyers. Bobbs-Merrill Co., Indianapolis and New York. $2.50. 235 pp.; ill. 1950.

More charm than is usual in books aimed at growing boys is to be noted in this sixth in Sam Campbell's Forest Life Series. Told as a narrative in the first person, with continuity provided by Hi-Bub, a youngster completing grade school and full of curiosity about the out-of-doors, the author carries the story easily and introduces a variety of birds and mammals. Notes on the undisturbed behavior of each, and on the reactions of many to man are introduced inconspicuously and well. The Moose Country is in Canada just across the border from Minnesota, and a considerable point is made of the need for conservation there, particularly because of unsympathetic and thoughtless people who now have access to the lakes by airplane. The spirit of the wildlife sanctuary is presented honestly and appealingly, with adequate background for its appreciation.

LORUS J. & MARGERY J. MILNE

A SAND COUNTY ALMANAC *and Sketches Here and There. By Aldo Leopold; illustrated by Charles W. Schwartz. Oxford University Press, New York.* $3.50. xiii + 226 pp.; ill. 1949.

A reviewer would have to be very young or very calloused to write a highly objective measure of this warmly glowing book. By use of words that show both a skilled command of descriptive language and a rare appreciation for outdoor events throughout the year (and country), Leopold enlists the full sympathy of the reader for his cause—the preservation of native animals and plants, of a wilderness and vacant spots on the map. Most of the writing is nostalgic, sad with the awareness that goes with much thinking on the contrast between the needs for conservation and present practice.

The author held a professorship of game management at the University of Wisconsin from 1933 on, so that he speaks from experience in likening his scientific colleagues to those who would take apart a musical instrument, describing its strings and sounding board, in a "process of dismemberment . . . called research." He points out in this biological analogy that "a professor may pluck the strings of his own instrument, but never that of another, and if he listens for music he must never admit it to his fellows or to his students." He deplores "an ironbound taboo which decrees that the construction of instruments is the domain of science, while the detection of harmony is the domain of poets." "Professors serve science and science serves progress. It serves progress so well that many of the more intricate instruments are stepped upon and broken in the rush to spread progress to all backward lands. . . If the professor is able to classify each instrument before it is broken, he is well content." It is the broken species, the burned forest, the wasted plains, that Leopold keeps before him in measuring the quid pro quo of man's spread across the continent. How long can the species *Homo sapiens* maintain his present, though brief, hold as Lord of Creation, if he continues to go contrary to every procedure in the rest of life—upsetting the balance of animal and plant economy wherever he goes?

With even the best motives toward conservation, Leopold sees a difficulty. Highways or skyways lead to the wilderness. The bogs that the pioneers drained for hayfields and then lost to fire, when rewetted by government direction, still offer poor shelter to cranes because of the new roads that "inevitably follow government conservation. To build a road is so much simpler than to think of what the country really needs. A roadless marsh is seemingly as worthless to the alphabetical conservationist as an undrained one was to the empire-builders. Solitude, the one natural resource still undowered of alphabets, is so far recognized as valuable only by ornithologists and cranes." "The ultimate value in these marshes is wildness, and the crane is wildness incarnate. But all conservation of wildness is self-defeating, for to cherish we must see and fondle, and when enough have seen and fondled, there is no wilderness left to cherish."

There is so much thought behind these pages, so much appreciation of the community of living things in terms as lasting as the mountains, that to pick noteworthy passages is to choose between fine and excellent. Leopold traces the history of his sand country in Wisconsin through the annual rings of a great oak as his saw cut into the heartwood of his lightning-shattered giant. He shows the reader that at daybreak he is the sole owner of all the acres he can walk over. "It is not only boundaries that disappear but also the thought of being bounded." His own farm was selected "for its lack of goodness," but he contrasts the number of plant species seen over a decade in first bloom on his "backward farm" with the number in the suburb and campus. The "total visual diet" of 226 on the farm to 120 in the civilized area leads on to a consideration of the shrinkage of the flora and the outstanding conservator of the moment—the railroad with its fenced right-of-way. Even the tree diseases have their measure of praise—as producers of twisted trees that shelter coons, of oak galls that feed the grouse, of hollow trunks in which wild bees build, of insect pests that nourish chickadees.

Of the monument erected in a Wisconsin state park to the memory of the Passenger Pigeon, Leopold writes again with sadness. "For one species to mourn the death of another is a new thing under the sun. The Cro-Magnon who slew the last mammoth thought only of steaks. The sportsman who shot the last pigeon thought only of his prowess. The sailor who clubbed the last auk thought of nothing at all. But we, who have lost our pigeons, mourn their loss. Had the funeral been ours, the pigeons would hardly have mourned us. In this fact, rather than in Mr. DuPont's nylons or Mr. Vannevar Bush's bombs, lies objective evidence of our superiority over the beasts."

Leopold tells with feeling of the bear, a huge grizzly, that lived on the Escudilla mountain in Arizona, and came down each spring to claim an annual cow as victim. A government trapper took the grizzly and "made Escudilla safe for cows." The land is still there, with Escudilla "on the horizon, but when you see it you no longer think of bear. It's only a mountain now." "We forest officers," and the author was one for 15 years, "who acquiesced in the extinguishment of the bear, knew a local rancher who had plowed up a dagger engraved with the name of one of Coronado's captains. We spoke harshly of the Spaniards who, in their zeal for gold and converts, had needlessly extinguished the native Indians. It did not occur to us that we, too, were the captains of an invasion too sure of its own righteousness."

To read these essays is to develop a deeper appreciation for the land and its wild life and a sharper eye and keener ear for its sights and sounds. Even the dust jacket ends with a sad note, however, for the gifted

author "died April 21, 1948, fighting a grass fire on a neighbor's farm in Wisconsin," little more than a month after finishing the book and writing the thoughtful foreword.

LORUS J. & MARGERY J. MILNE

THE WAY OF A PLANT IN FIELD AND GARDEN.

By Gareth H. Browning. Rockliff, London. 8s. 6d. x + 141 pp. + 7 plates; text ill. 1949.

Professional botanists are frequently asked by educated and intelligent laymen to suggest a book from which they can learn something about the way plants work. It is not easy to name one, because there are not many such and they are difficult to judge. It is hard for a person trained in a science to remember what it is like to be almost completely ignorant of his whole field of knowledge. Some of the books he might recommend would be too hard and some too easy for the lay reader. Of course, some might be excellent for certain people, but fail completely to tell the things another person wants to know. All this indicates that this reviewer's enthusiasm for Gareth H. Browning's *The Way of A Plant* might be a feeling exactly opposite to that held by some other botanist. What some non-botanists think of it should be found out, for the book is written for them. One such person said it was excellent, so clear that he could really follow it right through. The only other available person who had tried it said he was left with more questions than he had had before. Fortunately, he liked that feeling, because he appreciated as never before that plants are complicated and that there is a lot to be learned about them. His interest in what plant scientists and biochemists, farmers and flower growers are trying to do was really awakened. An author who can do that for the layman has written a book worth knowing about.

The person who knows plants from having struggled to make them grow in a vegetable or flower garden or the person who knows wild plants should find this book very useful in giving him an understanding of the requirements for plant growth. Some of the examples used may be best known to British plant enthusiasts, but there is no real provincialism in the selection of material. The soundness of the interpretations of modern plant science and the simple clarity of the exposition make *The Way of a Plant* the book all my inquiring friends will have recommended to them.

HARRIET B. CREIGHTON

SEA AND SHORE.

By Clarence J Hylander. Macmillan Co., New York. $3.00. x + 242 pp.; ill. 1950.

Here is a book which a zoologist may safely purchase for his children, if he lacks the time to answer their questions himself. It describes the seashore life of both Atlantic and Pacific coasts of the United States, plant as well as animal, and presents the basic facts of the environment in simple terms. It is intended for juvenile readers from about 10 to 14, but is in no way "written down" to insult their intelligence. While most of the space is devoted to the mollusks, echinoderms, and crustacea, the basic anatomy of sponges and coelenterates is also presented, with the aid of simple but adequate diagrams. Most of the common species of both coasts are illustrated, either by line drawings or by photographs. The idea of photographing the shells as if they were found cast on the beach is an especially happy one. Unfortunately some of the photographs, especially of tide pool scenes, have been reproduced too faintly, in the subdued gray of the offset process. While there are a few minor slips, such as the use of "tongue" for "radula," the book as a whole is well done and the author is to be congratulated upon a good job.

JOEL W. HEDGPETH

EVOLUTION

SPECIATION IN SALAMANDERS OF THE PLETHODONTID GENUS ENSATINA. *Univ. Calif. Pub. Zool., Vol. 48, No. 6.*

By Robert C. Stebbins. University of California Press, Berkeley and Los Angeles. $2.50 (paper). Pp. 377–526; ill. 1949.

When Alden Miller wrote his monograph of the juncos, he established a very happy tradition at the University of California. In that classical paper he first studied the variation in the characters of birds and related them to geography. After he had those relations clearly defined, he then proceeded to the second phase of the problem, a revision of the systematics of the genus.

The present paper offers a study of a genus of salamanders in the same fine tradition. First an analysis of their variation in external characters is made, with an attempt to interpret this variability geographically and ecologically. Then, as a byproduct rather than an end in itself, comes a systematic revision of the genus. *Ensatina* contains a single species and seven subspecies, recognized by Stebbins. It is limited to the West Coast, getting across the border into Mexico and into Canada only to a very slight extent.

This rather large report is, without doubt, the most outstanding study of a genus of American salamanders that has yet appeared. Careful work has been done on the arrangement and quality of the pigmentation, and a great deal of living material has been examined. The report is well illustrated with a number of colored plates done by the author.

Probably the most interesting aspect of the entire report concerns the distribution of the recognized races.

In the general zoological literature one may find a number of alleged instances in which the end members of a chain of subspecies meet and are specifically distinct. Many investigators have sought for such Rassenkreise in American salamanders. As far as I am aware, the present is the first serious attempt to demonstrate such an overlapping chain. The weakest part of Stebbins' argument is the consideration of the case where the two ends, *Ensatina e. eschscholtzii* and *E. e. klauberi* overlap in southern California. From this area there is a paucity of material and the "specifically distinct" races lack a few miles of being found together. The situation is very suggestive but is still not a clear-cut demonstration of the overlapping chain.

Another interesting geographic feature is the range of *E. e. xanthopicta*. This race is limited to two small areas, one in the Coast Range and the other in an even smaller pocket in the Sierra Nevadas. Between the two mountain ranges is the Great Valley of California, which does not seem to contain suitable habitats for *Ensatina*. Stebbins suggests, and documents his suggestions, that there was an acceptable connecting habitat during the Middle Pliocene. If so, it offers an opportunity to date speciation processes.

There are minor ways in which the paper may be criticized. For example, California localities are discussed so cursorily that many eastern biologists may find it disconcerting. The distribution maps do not show those geographic features (e.g., life zones, altitudes) with which the ranges seem to be correlated. On a plate showing only 15 specimens, the individuals are numbered for identification, whereas they could have been named directly just as easily.

On the whole, this is a most important contribution with a very critical analysis of basic characters. It is carefully done, and the illustrations are superb.

ARNOLD GROBMAN

MEGASPORES FROM THE MICHIGAN COAL BASIN. *Contributions from the Museum of Paleontology, University of Michigan, Vol. VIII, No. 5, June 2, 1950.*

By Chester A. Arnold. University of Michigan Press, Ann Arbor. $1.50 (paper). Pp. 59–111 + 18 plates. 1950.

STRATIGRAPHY AND PALEONTOLOGY OF THE BROWNSPORT FORMATION (SILURIAN) OF WESTERN TENNESSEE. *Peabody Museum of Natural History Bulletin 5.*

By Thomas W. Amsden. Yale University Press, New Haven; Geoffrey Cumberlege, Oxford University Press, London. $5.00. viii + 138 pp. + 1 map + 4 charts + 34 plates; text ill. 1949.

In this detailed study of the classic Silurian area of western Tennessee, Amsden disagrees with earlier writers who subdivided the Brownsport formation into members. He recognizes the Brownsport as a single unit between the subjacent Dixon formation and superjacent Decatur formation, and abandons the subdivisions given by Pate and Bassler of Beech River, Bob and Lobelville. His thickness data also differ from earlier figures, as he has from 100 to 120 feet for the Brownsport formation, whereas Pate and Bassler gave a composite thickness of 257 feet with a maximum of 109 feet at a single locality.

Amsden believes that the type locality for the "Beech River" includes all the formations of Pate and Bassler, and does not represent Beech River overlain unconformably by Decatur. At the type locality for the "Bob" formation, Amsden found no lithologic basis for separation of the Bob as a distinct formation. However, he states that the brachiopod fauna is well developed in this central portion of the Brownsport formation, although most of the species range throughout the formation. Amsden believes that the lithologic unit referred to the "Bob formation" by other writers is merely a series of discontinuous limestone lentils that do not always occur at the same stratigraphic level.

The facies concept is used to explain the feature previously considered due to unconformities removing "formations" within the Brownsport. As an example Amsden discusses the section at Sewell Spring, where the *Rhipidium* zone of the "Bob formation" lies above the rich coral horizon of the "Lobelville formation." He also demonstrates that the "Lobelville," or coral-bearing beds of the Brownsport, occurs at the base of the formation as well as at the top, suggesting that the "formation" as previously defined, is in reality an occurrence of a facies fauna at varying stratigraphic levels.

The Brownsport is correlated by Amsden with the Louisville, Bainbridge, Henryhouse and certain dolomites of the Chicago area.

In the paleontologic portion of this study, 18 new species of brachiopods, one new cystid, one new genus, *Romingerella*, and 19 new species of corals are described.

ALFRED R. LOEBLICH, JR.

GENETICS AND CYTOLOGY

VARIATION AND EVOLUTION IN PLANTS.

By G. Ledyard Stebbins, Jr. Columbia University Press, New York. $8.00. xx + 643 pp.; ill. 1950.

Three decades ago geneticists studied genetics, cytologists studied the cell, and taxonomists occupied themselves wholly with taxonomic matters. Even at those rare moments when they got together and discussed general problems of evolution, each group used its own habits of thought. All three misunderstood the way in which the terminologies used by the others ought to

be applied to their own problems. The discussion was at cross purposes and there was no effective interchange of ideas. Certainly the eminent geneticists with whom I studied as a graduate student, though they may have occasionally wandered into an herbarium, were not only ignorant of the techniques of taxonomy—they were naively unaware that they misunderstood the working concepts and professional goals of their taxonomic colleagues. As for the taxonomists—pursuing their ancient pipe dream of some day finding a place that would be marked with little X's in one species and with little Y's in another, if they thought about chromosomes at all, it was only in the hope that these might prove to be technically diagnostic and differ conveniently in number or in some other easily catalogued character from species to species.

Today these separate fields are so closely integrated along their area of contact that Stebbins' new book is but one of several which consider the common problem of these and other disciplines. This rapid advance was made possible by a very few of us who rushed in where wiser people had hesitated to tread. Gradually we learned that there were fundamental facts about our sister disciplines which we did not understand. We taught ourselves and eventually we even unlearned a good deal, which is a much more difficult process.

From his student days, G. Ledyard Stebbins was an acknowledged leader in this group. He alone was both an exceptional cytologist and an able taxonomist. His close association with the outstanding geneticists at Berkeley gave him an inside view of that discipline, and his interest in the work of his paleontological colleagues rounded him out in yet another direction. One therefore turns to his book with keen anticipation. This should be no such naive volume as *The New Systematics*, where the species problem is brilliantly and repeatedly discussed by a group of visiting experts from other fields. Nor is one disappointed. *Variation and Evolution in Plants* is inclusive, informed, clearly written, and so thorough as occasionally to verge on the ponderous. The subject is presented in the round, with Stebbins' own particular and private interests subordinated to the whole. There is nothing parochial in his outlook; the illustrative material is chosen from the biological literature of the world. A number of significant items, previously published but generally overlooked, are brought to public attention.

Stebbins begins his book by devoting a full forty pages to a description and discussion of the methods used in studying variation patterns. He justifies this course by pointing out that one's understanding of a science is critical only when one appreciates the weaknesses as well as the advantages of the methods used in gathering its basic data.

He then discusses the actual patterns of variation in several genera and species, by way of example, and passes on to a review of the germinal basis of variation. After illustrating the ways in which Natural Selection acts upon this variation, he then develops Darlington's concept of the evolution of genetic systems themselves. There are full-dress reviews of the evolutionary importance of hybridization, polyploidy, and apomixis in plants, and two chapters on trends in evolution, one on evolutionary trends affecting the chromosomes themselves, the other on long range trends in external morphology. The book closes with a consideration of the fossil evidence of plant evolution and a discussion of evolutionary rates. Stebbins concludes that these differ enormously between different organisms at the same time and place, or within the same organism at different times and places. He amplifies Schmalhausen's theory of the dependence of evolutionary rate upon the ecology of reproduction and applies it to specific examples in the evolution of the higher plants. There are 55 text figures, a 60-page bibliography, and a good index. The book should prove equally useful as a textbook in its own field, or as an introduction to the subject for scholars working in other fields.

EDGAR ANDERSON

PRINCIPLES OF HUMAN GENETICS.

By Curt Stern; illustrations by Aloha M. Hannah. W. H. Freeman & Co., San Francisco. $5.50 (text ed.); $7.50 (trade ed.). xii + 617 pp.; ill. 1949. The growing interest in human heredity has created a problem for teachers of genetics. They have encountered an increasing number of students who are primarily interested in human heredity. Other students prefer to study genetics to prepare themselves for the experimental field and are only secondarily interested in human genetics. Many schools have attempted to meet the needs of the two groups of students by giving one course in elementary genetics which in a sense can alternately keep the interest of the two student groups. Even the teacher who was fortunate enough to have time to give a separate course in human genetics has been hampered by the lack of a suitable text book to which the students could be directed for supplemental readings.

Recognizing the needs of both the student and teacher, Stern has prepared a text book to be used for teaching "the fundamentals of genetics by way of a study of human inheritance." The author has also endeavored to include in the book material of use to professional people who may be asked to give genetic counseling. The double aim is worthy but the task is about as difficult as that of preparing a single text to be used by the pre-specialist as well as those who are more interested in medical or human genetics.

The first part of the book serves as an introduction to some of the fields basic to an understanding of genetics. The topics include embryology and cell division, nature of gene action (possibly a bit complicated for a beginner), gamete formation, probability

and simple mendelian inheritance. Examples to show the rules of inheritance have been chosen from among traits in man. Exceptions to the general rules and the difficulties in interpreting family histories because of decreased penetrance and expressivity are saved until later chapters, after the student has been better prepared to understand such problems.

Methods used in the analysis of human genetics data are given in separate chapters as well as included as parts of other chapters where they fit. Experience shows that the average beginning student in genetics and the general reader who has little understanding of the elements of genetics do not readily grasp the statistical methods developed for the study of human genetics. One can only hope that these readers will not be discouraged from using the book when they continue to be slowed down by the statistical methods scattered throughout the book. Certainly the author has done a credible job in developing these parts of the text. He has started out with the more simple methods and explained them clearly and fully before continuing to the more complex. Students of human heredity who have had some training in genetics will welcome a text which presents methods of study as well as data about heredity in man.

Practically every general phenomenon in genetics has been incorporated in the middle portion of the book. References to experimental organisms have been kept to a minimum. Here are found discussions of multiple alleles, sex-linkage, genic maps, sex determination and differentiation, consanguinity, and the complications arising from expressivity and decreased penetrance. The author refers to the aims and desires of persons working in human genetics. He calls attention to some of the more pressing problems confronting the worker and to the types of data geneticists are collecting to aid them in their counseling problems.

The effects of internal and external environmental agents on gene action and on dominance of a gene are discussed. There is a relatively long treatment of the effects of the mother on the progeny developing within her. For this purpose, studies made with experimental animals are discussed, as they might well be since the animals can be subjected to tests, but references to man are also given. One misstatement occurs and should be corrected. The author states (page 313) that "All twins with identical genotypes have been found to be alike in regard to this defect, either both being free from it or both affected. On the contrary, among pairs of genetically nonidentical twins in which Mongolism occurred, only one individual was affected." This opinion has been given frequently in the past but most likely is incorrect. There seem to be at least three sets of dizygotic twins reported in the literature in which both of a pair are mongoloids. Because of the earlier belief that dizygotic twins always differed for mongolism, one investigator who reported a pair with both members affected concluded that he therefore had evidence against heredity as a factor in mongolism. Obviously the conclusion was not justified. Yet a geneticist must be careful not to blow the flame of controversy in the wrong direction.

In the last part of the book, the author gives consideration to racial differences and racial problems. The subject is amply treated as an introduction to the genetics of race.

Problems to test the student's ability to apply what he has read are given at the end of most chapters. These self-tests are always valuable to a student and should be included in an elementary text book of genetics. Value of particular problems can be determined only after usage.

The author set himself a difficult task. It is no simple matter to prepare a text which can be used to teach the elements of genetics to a beginner and also used in counseling. So many special methods of analysis are necessary for interpreting the genetics concerned in the history of a family or group of histories of similar traits that the inclusion of the statistical methods removes the book from an elementary type. Those students who have had some training in the basic phenomena of genetics will get the most good out of the book. In all, the author has prepared a good and useful text book which will meet many of the needs for a treatment of human genetics. As is true of any book, errors have slipped by the author and copy reader. We can rest assured that these errors are being tracked down.

CLARENCE P. OLIVER

TEORIA DELL'URTO ED UNITÀ BIOLOGICHE ELEMENTARI. *Galileo. Volume I.*

By Adriano Buzzati-Traverso and Luigi L. Cavalli. Longanesi & C., Milano. L. 600.—(*paper*). 254 pp.; ill. 1948.

This book was published at about the same time as the proceedings of the Paris Symposium on *Biological Units Endowed with Genetic Continuity*. It constitutes an essential complement to those proceedings, emphasizing, as it does primarily, the biophysical approach to the nature of self-reproducing particles. The book brings together extensively, yet very clearly, the experimental and theoretical background of what may be called, for short, radiation genetics. It stresses the bearing of radiation genetics on what may be visualized as general among self-duplicating biological structures, namely that they may mutate, or be inactivated as a consequence of a single ionization, or small cluster of ionizations.

The authors are well aware of the limitations of this approach, but they take a rather hopeful view. I am myself rather sceptical about the present promise of radiation genetics as a tool for the investigation of ele-

mentary biological units. After all, one would not expect to get a deep insight into the nature of a ship by studying the efficiency of different types of gunfire in sinking it. However, this book is an indispensable reference for anyone who wishes to be acquainted with the ideas and ingenious experiments which have led to the present state of radiation genetics. Besides, it is very well written and thoroughly thought out, and it makes pleasant reading.

G. PONTECORVO

MYOTONIA. *Thomsen's Disease (Myotonia Congenita), Paramyotonia, and Dystrophia Myotonica. A Clinical and Heredobiologic Investigation. Opera Ex Domo Biologiae Hereditariae Humanae Universitatis Hafniensis. Volume 17.*

By Eivind Thomasen. Universitetsforlaget i Aarhus; Ejnar Munksgaard, Copenhagen. Kr. 20.00 (paper). 251 pp.; ill. 1948.

This monograph deals with the results of an extensive clinical and genetical study of three diseases which in the past have been recognized as closely related: myotonia congenita or Thomsen's disease, paramyotonia, and dystrophia myotonica. As the terminology would suggest, myotonia is a feature common to all three diseases. However, they differ with respect to the stimuli which elicit the myotonia, the age of onset, the muscle groups affected, and the associated symptomatology. Reasons are advanced for including in this well-recognized disease group a rare fourth entity, characterized by the association of myxedema with muscular hypertrophy and myotonia (Hoffmann's syndrome).

Each of the diseases is carefully delineated. Particular attention is directed towards dystrophia myotonica. The myotonia in this disease is most often seen in single symmetrical muscular groups, especially the flexors of the fingers. In later life, muscular dystrophy affecting particularly the facial, masticatory, lingual, cervical, and forearm musculature appears. The association of cataracts and gonadal dystrophy reported by others was evident in the present series, where 87% of the affected persons exhibited cataract, 86% of the males were found to have testicular atrophy, and 64% of the females had menstrual disturbances. Frontoparietal baldness was seen in 83% of the affected males and 16% of the affected females. Mental and social deterioration is not uncommon.

There is no evidence that Hoffman's syndrome is inherited. The other three diseases as a rule exhibit dominant heredity. In myotonia and paramyotonia the responsible gene is usually completely penetrant. However, in dystrophia myotonica the dominance seems to be more irregular, although it is the author's opinion that careful study of the transmitters of the disease in affected families will almost always bring to light some stigma of the condition. In particular lenticular opacities are commonly seen in otherwise healthy relatives, especially parents, of patients with dystrophia myotonica. It is felt that this offers an important clue in the detection of the genetic carriers of the disease. Within any affected group the type of disease is constant, i.e., there is no evidence that myotonia, paramyotonia, and dystrophia myotonica are all variable manifestations of the same gene. This careful study sheds important light on a related group of conditions which have not heretofore been as clearly delineated as is desirable.

JAMES V. NEEL

SYMPOSIUM ON RADIATION GENETICS. *Sponsored by The Biology Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee, March 26–27, 1948. Reprinted from Journal of Cellular and Comparative Physiology, Vol. 35, Supplement 1, June 1950.*

Published by The Wistar Institute of Anatomy and Biology, Philadelphia. Free upon request (paper). 210 pp. 1950.

The Information Meetings for Biology and Medicine, held under the sponsorship of the Atomic Energy Commission at Oak Ridge, are designed to bring together those scientists doing active research in particular fields of radiation biology. The first one, held in March 1948, was particularly important because much of the restricted information gathered during the war had been declassified, but was not yet generally available. The talks and the unrestricted discussions which followed have been brought together by A. Hollaender in the present symposium volume. The papers presented were as follows: Genetic Effects of Radiation (Muller); Effects of X-Rays on Chromosome Structure (Sax); Chromosomal Interchanges Induced by Fast Neutrons from Uranium Fission (Giles and Conger); Effects of Radiation on Mitosis (Carlson); Results of the Bikini Test on the Cytology of Maize (Randolph); Effects of Radiation on Fungi (Tatum); Effects of UV Radiation on Microorganisms (Wyss, Haas, Clark, and Stone); Induced Nutritional Mutations in *Salmonella* (Plough); Effects of Radiation on *Paramecium* (Kimball); Inactivation of Enzyme-Substrate Film by Small Doses of X-Rays (Mazia and Blumenthal); and Population Genetics and Radiation (Wright). It is to be hoped that the 1949 and 1950 symposium volumes will not suffer as long a delay in publication.

C. P. SWANSON

THE NATURE-NURTURE CONTROVERSY.

By Nicholas Pastore; with a foreword by Goodwin Watson. King's Crown Press, Columbia University, New York. $3.25. xvi + 213 pp. 1949.

In the author's own words "the object of this study is to investigate the relationship between the outlook of scientists on controversial nature-nurture problems and their attitude toward social, political and economic questions." The inquiry is based on the views, in both fields, of 24 American and English scholars. This group included the following persons in the professional classification used by Pastore. Six geneticists: William Bateson, Lancelot Hogben, J. B. S. Haldane, C. B. Davenport, E. M. East, H. J. Muller; 3 biologists: F. A. Woods, P. Popenoe, H. S. Jennings; 1 anthropologist: Franz Boas; 10 psychologists: Francis Galton, William McDougall, E. L. Thorndike, H. H. Goddard, L. M. Terman, L. S. Hollingworth, J. McK. Cattell, F. N. Freeman, G. D. Stoddard, J. B. Watson; 1 statistician: Karl Pearson; 2 sociologists: L. F. Ward, C. H. Cooley; and 1 educator: W. C. Bagley. The author tells us that he chose these particular individuals because they had (in his opinion) taken a definite stand in the "nature-nurture controversy" and had also expressed more or less definite opinions on social, political, and economic questions. The major part of the book is devoted to sketches of each of these persons, leading in most instances to statements such as that X "can be classified as a hereditarian with regard to nature-nurture issues and a conservative with regard to social and political questions" or that Y was "a consistent environmentalist and a consistent liberal." The net results of this census of opinion are about as follows. By sheer magic the group consists of a neat dozen each of "hereditarians" and "environmentalists." All but 1 of the 12 environmentalists are diagnosed as liberals or radicals, and similarly there was but 1 exception to all of the hereditarians being conservatives. The author's final interpretation culminates in the statement that "the sociopolitical allegiances of the scientists were a significant determinant of their position on nature-nurture questions" and that "these allegiances had a marked effect upon the formulation of a hypothesis and the method of its verification, the conclusions drawn from an investigation, and the statement of implications of these conclusions for society."

The reviewer can think of no standard by which this book is not a distressing performance. It is impossible here to go into an analysis, case by case, but the following remarks should suffice. In the evaluation of his material the author has given no weight whatever to the kind of evidence which persuaded one or another of his guinea pigs to place greater or less emphasis on the force of genetic or environmental factors; one man's poorly founded opinions are taken at the same face value as another man's well reasoned conclusions derived from scientific evidence. Unless one is ready to imply gross insincerity on the part of those who have something more to offer than opinions, this procedure is obviously unfair. It may be asked how reliable is the author's procedure of classification according to the "nature-nurture controversy." In this respect every geneticist will be surprised to learn that J. B. S. Haldane, Lancelot Hogben, H. S. Jennings, and H. J. Muller are treated as "environmentalists." In one case at least (that of Muller) the author admits that this classification was done over the protest of the party concerned. One may, of course, defend the viewpoint that Pastore knows better, but few biologists will agree with him. And this leads us finally to the total absurdity of the author's classifying scheme. Although he is aware of the fact that for quite some time (and presumably for all the biologists referred to in his book) the antithesis of heredity versus environment has ceased to exist in biological thought, this consideration is brushed aside and every biologist is labeled to the author's satisfaction. One presumes that this classification was particularly pleasing to the author since it resulted in a perfect correlation of nature-nurture niche and political outlook. Sic transit multa simplificatio.

WALTER LANDAUER

HEREDITY IN ESSENTIAL HYPERTENSION AND NEPHROSCLEROSIS. *A Genetic-Clinical Study of 200 Propositi Suffering from Nephrosclerosis. Opera Ex Domo Biologiae Hereditariae Humanae Universitatis Hafniensis. Volume 16.*

By Paul Sǿbye. Nyt Nordisk Forlag, Arnold Busck; and Ejnar Munksgaard, Copenhagen. Kr. 20.00 (paper). 225 pp.; ill. 1948.

This monograph in the series from the University Institute of Human Genetics at Copenhagen is the most ambitious attempt to date to treat the hereditary factor in essential hypertension and nephrosclerosis. In his treatment the author makes two related basic assumptions concerning his subject matter which are, in part at least, debatable and so should be underscored. The first is that essential hypertension (elevated blood pressure in the absence of any known precipitating factor) and nephrosclerosis (elevated blood pressure and moderate proteinuria, in the absence of hematuria, and with no history of antecedent renal disease) are essentially the same disease. The second assumption is that all cases of these two (identical) diseases have the same genetic basis. The reviewer sees here the same cloud that hangs over the head of genetic research in, for example, diabetes mellitus—the growing probability that the clinically observed end result may be subdivided into a number of separate entities, for each of which a separate genetic mechanism must be considered.

The starting point for the investigation consisted of 220 individuals with hypertension and proteinuria and with a negative history for renal disease. It was possible to carry out genealogical studies on 186 of these patients. Information was collected on 2740 relatives of these 186 patients. Of the 2023 relatives over 30 years of age, the author personally examined 753 cases, while data on 362 cases were derived from hospital case

records, data on 172 by correspondence with their personal physician, and data on the remaining 736 from death certificates. For living individuals, the diagnosis was primarily based upon 1 or more blood pressure determinations and 1 or more examinations of the urine. For deceased individuals, diagnosis was on the basis of a death certificate supplemented by hospital records where available. Death because of a cerebrovascular accident, or the finding of cardiac hypertrophy at autopsy, was taken as indicative of hypertension. For 176 of the families (94.6%) it was possible to demonstrate within the family one or more additional cases of essential hypertension, nephrosclerosis, isolated cardiac hypertrophy, and/or cerebrovascular accident.

Control figures are derived for the age-incidence relationship in the general population of essential hypertension, nephrosclerosis, and cerebrovascular accident. Figures are then given for the probability that various categories of relatives will develop essential hypertension and nephrosclerosis. Since the conditions under discussion are related to age, a correction must be introduced to derive comparable figures for the expectation of developing essential hypertension and nephrosclerosis in various categories of relatives at a given (advanced) age. It is concluded that various categories of relatives of patients show a definitely increased incicence of these conditions as compared with the general population. The reviewer finds himself puzzled by the fact that whereas (p. 116) the incidence of nephrosclerosis and essential hypertension in the population is placed at 30–40%, it is stated (p. 105) that corrected chance of affection in parents' sisters and parents' brothers is 26.84% and 20.59% respectively, i.e., less than the incidence in the population at large.

It is concluded that the tendency to develop essential hypertension and nephrosclerosis depends on a dominant gene. A correlation was observed between siblings with respect to age of onset (recognition) of hypertension and nephrosclerosis. It was felt that the incidence of gout and diabetes mellitus was slightly increased among the relatives of the patients, while the incidence of alcoholism and adiposity was definitely increased. The observed mortality rate was found to be higher in the families studied than in the general population. It was not possible to associate the development of essential hypertension with a particular somatotype.

From the clinical point of view, here is a collection of detailed observations never before equalled. The reviewer's chief criticism is directed towards the attempt to treat all essential hypertension and nephrosclerosis as a genetic entity. No one can prove at present that this is definitely not the case. However—to mention only one theoretical objection—if all essential hypertension is due to the same gene, then in view of the increased mortality among hypertensives and the frequency of the disease we are confronted with some rather knotty problems in selection and mutation.

JAMES V. NEEL

GENERAL AND SYSTEMATIC BOTANY

WATER IN THE PHYSIOLOGY OF PLANTS. *A New Series of Plant Science Books. Vol. XXI.* *By A. S. Crafts, H. B. Currier, and C. R. Stocking. Chronica Botanica Co., Waltham, Mass.; Stechert-Hafner, New York.* $6.00. xxii + 240 pp.; ill. 1949.

Water is so intimately connected with life that many times we are prone to give but little thought to the subject. Maximov's book, *The Plant in Relation to Water*, was the last treatise on this fundamental problem that most plant physiologists are familiar with. During the 20-year period since that book was published a sizeable body of new information and ideas has appeared. Much of this literature is contradictory and very difficult to read. One soon becomes engulfed in the terminology: DPD, OP, WP, TP, T, O, suction tension, etc. The authors of *Water in the Physiology of Plants* deserve the appreciation of biologists and plant physiologists for their effort to give a comprehensive picture of present knowledge of the water relations of plants.

A critical evaluation has been made of the numerous experimental methods that have been used in studying the water relations of plants. Graduate students and research workers will find this material especially worthwhile. Not only do the authors point out the errors and shortcomings of the methods but also indicate new and perhaps more rewarding methods of approach. Where a controversy exists, the authors present all sides and then give an intelligent explanation of why they prefer a particular point of view.

The extensive literature on plant and soil water relations is but briefly considered. If it is assumed that the plant has an ample water supply available, then the literature on the uptake and internal distribution of the water is very thoroughly covered.

The first 5 chapters are rather technical in nature and deal with a physical chemical description of water and solutions. The chapters on osmosis and the mechanism of osmosis are very worthwhile and deserve careful scrutiny. The last 5 chapters deal with the physiological aspects of water in the life of the plant and will be more familiar to the plant physiologist. The chapters concerned with the uptake and movement of water in plants and with water loss and water retention are outstanding. Since the authors have themselves contributed to the literature in these fields, they are able to give a critical evaluation of the subject matter.

Each chapter is followed by a brief and informative summary. The author and subject indices have been carefully and thoroughly prepared. The book has much to recommend it to biologists in general and to plant physiologists in particular.

G. R. NOGGLE

BIOLOGIE, ANATOMIE ET PHYSIOLOGIE VÉGÉTALES. *Principales Familles et Fermentations. Ninth Edition. By Antoine Pizon. G. Doin & Cie., Paris.* 130 fr. (paper). 636 pp.; ill. 1943.

Notwithstanding its title, this book may be regarded as a textbook of general botany and as such readily compared with other standard text books. Although complete agreement of opinion concerning the contents of courses and textbooks of general botany may never be attained, certain fundamentals are now sufficiently well established to be treated in almost all texts. *Biologie*, etc. is divided into 5 somewhat unequal parts: (1) cellular biology (pp. 11–60), (2) organography and plant nutrition (pp. 63–307), (3) reproduction (pp. 309–514), (4) summary of families of flowering plants (pp. 517–609), and (5) fermentations (pp. 613–630). Part 5 could logically have been included in the main part of the text. This brief outline clearly reflects the author's intention of assisting the student, as far as possible, in acquiring a better understanding of the physicochemical phenomena characteristic of life. Much interesting material is presented in easily readable form, including Dangeard's interpretation of fecundation, intracellular respiration, etc. Clear diagrams are effectively used in illustrating complicated phenomena, e.g., Fig. 184, showing the "ascent of sap." The outlines of the principal life histories of representative groups are uniformly constructed and easily compared with one another.

The classification of the plant kingdom adopted by the author differs considerably from the systems currently used elsewhere. For instance, the protophytes (*Protococcus* and Bacteria) are contrasted with the metaphytes, comprising the cellular cryptogams (algae, fungi, lichens, and bryophytes) and the vascular plants (vascular cryptogams and phanerogams). The old family Confervaceae is recognized, containing *Oedogonium* and *Cladophora*. More serious is the omission of subject matter now commonly regarded as essential material in general botany, such as genetics, ecology, microbiology (other than fermentations), and paleobotany. Unfortunately the book has neither an index nor a glossary. It is hoped that in the first post-war edition the author will not only take cognizance of the great advances made in botany outside of France but will also include appropriate chapters dealing with genetics and other modern aspects of botany.

THEODOR JUST

BOTANY. *A Textbook for Colleges. Second Edition. By J. Ben Hill, the late Lee O. Overholts, and Henry W. Popp. McGraw-Hill Book Co., New York, Toronto, and London.* $5.00. xvi + 710 pp.; ill. 1950.

For some reason, this excellent 2-semester textbook in botany has never achieved the popularity accorded other less well-done volumes of similar length and scope. The second edition is as complete in its coverage as the first (cf. *Q.R.B.*, 12: 115). Advances in the physiology of plants which have appeared since 1936 have been well integrated with earlier information, and a number of changes and additions have been made in the taxonomic chapters. A single, but major criticism can be made. A discussion of heredity, which logically should be of equal importance with the other aspects of botany, appears in the final chapter following the taxonomic treatment. It appears almost as an afterthought, put in at the last moment, and the chapter is fragmentary and poor in contrast to the earlier, more complete chapters on the growth, physiology, and anatomy of plants. An incorporation of the genetics of plants into the body of the text, rather than as an appendage, would improve the book materially.

C. P. SWANSON

BOTANY. *An Introduction to Plant Science. By Wilfred W. Robbins and T. Elliot Weier. John Wiley & Sons, New York; Chapman & Hall, London.* $5.00. x + 480 pp.; ill. 1950.

This book begins with 3 chapters of general remarks on botany, the plant world, and classification. These are followed by chapters on the cell, stem, roots, leaves, flower, fruits including seeds and seedlings, inheritance, physiology, a series of chapters on the different groups of plants, and finally a brief discussion of evolution. While this sequence is no more reasonable than in most of the present textbooks of botany, except in the location of the chapter on inheritance, many of the details of handling the particular subjects are excellently done. The authors follow a pattern of repetition which is necessary for a large percentage of students; the subject is briefly surveyed, then discussed in detail, and finally summarized. A system of classification is used which is a great improvement over the archaic system of Thallophytes, etc., that should have been discarded years ago. It includes 15 phyla, 12 of which are described in some detail. The discussion of vitamins occupies 5 pages. It points out in much better fashion than most botany books the importance of vitamins to the plant. It even takes care to point out our ignorance of the functions of some of the vitamins. In connection with the discussion of the bacteria the surface-volume relationships of this group are discussed, but without extension to all plants. The outlines of the life cycles for all sexually reproducing plants are very well done and should be a great help to students.

Most of the figures (there are more than 450) are excellent. About 26 of the photographs are poor, but this is not an excessive proportion when one considers the total number and that this is the first printing of the book. Some of the electron photomicrographs are su-

perb. Great care has been taken to place each figure on the page near the text discussion which it illustrates.

The major criticism of this book is that it fails to teach science as a moving, growing, developing human activity. The authors make a few attempts in this direction, as illustrated by part of their discussion of photosynthesis and part of their discussion of water absorption, but they fail to treat any of the major concepts as though they are temporary or initial steps in a growing science. To be efficient in teaching science one must organize as much of the descriptive material as possible around the major theoretical concepts. Since the theory of evolution is the most important concept in botany, it should receive early discussion so that, as the book progresses, the facts will add to the concept and in turn the concept will give broader meaning to the facts. The authors have done this, at least in part, in relation to inheritance, although they fail to discuss biochemical genetics, a development of modern botany which would be an excellent vehicle for teaching science as a moving process. It is not increasingly difficult, as the preface states, to determine what to include in an elementary textbook of science if the authors will attempt to arrange the classes of facts in relation to the major concepts of the science. In so doing it is also possible more easily to portray science as something dynamic, growing, and developing. One can say that such things in science cannot be taught to freshmen, but this is no longer a valid statement, because it is actually being done. One can also say that the burden of such teaching falls on the teacher and that the textbook is simply a catalogue of the established facts. If we accept this, one cannot rightly call a book of this sort "an introduction to plant science," because the word science implies much more than encyclopedic knowledge.

Two means by which the subject matter of botany can be made to teach science are the discussion of the development of established concepts and facts, and the discussion of modern problems. The inclusion of a half dozen examples of each would do much to add "science" to a book of this sort and, if carefully chosen, would not much increase the space already allotted to the simple description of the facts. Models of this type of textbook writing are Carlson and Johnson's *The Machinery of the Body* and Hardin's *Biology, Its Human Implications*.

To be fair one must remember that the teaching of the biological sciences has been, until recently, largely a matter of memory exercises. Imagination and logic were not companions, in any conscious way, of memory in the classroom or at the study table. Now they are beginning to take their rightful position, and this should begin to show in all textbooks of science. The criticisms in the above paragraphs are generic and therefore much less harsh than the words might imply. Considered from the viewpoint of orthodox botany teaching this book is a thorough and well organized treatment of the subject. It is written in a clear style, and its format and mechanical make-up are excellent.

RALPH W. LEWIS

ANNOTATED DISTRIBUTIONAL LIST OF THE FERNS AND FLOWERING PLANTS OF SAN DIEGO COUNTY, CALIFORNIA. *No. 8.*

By Ethel Bailey Higgins. San Diego Society of Natural History, San Diego. $1.25 (paper). vi + 174 pp. + 1 map; text ill. 1949.

This is an annotated check list of about 1800 species and varieties of native and introduced vascular plants known to occur in San Diego County. It is based upon the herbarium of the San Diego Society of Natural History, which has in turn been checked for determinations not only by the author but also by a number of specialists in certain families and genera. Under each species are notes on frequency and habitat, and the citation of herbarium numbers. The nomenclature is essentially that of P. A. Munz' *Manual of Southern California Botany*. There is a brief list of references to related books and manuals, and an index to names. A folded-in map illustrates the life zones of San Diego County and contains a gazeteer of localities cited in the text. The book is in paper and is printed by offset lithography.

H. M. RAUP

ESQUISSE GÉNÉRALE DE LA FLORE VASCULAIRE DES ILES SAINT-PIERRE ET MIQUELON, SUIVIE D'UN SUPPLÉMENT SUR LES ALGUES MARINES. *Contrib. Inst. Bot. Univ. Montréal. No. 65, October 1949.*

By C. le Gallo. Université de Montréal, Institut Botanique, Montréal. 50 cents (paper). 84 pp.; ill. 1949.

Le Gallo's paper was originally published in parts in the *Naturaliste Canadien* (1947), and is here reprinted with some modification. as a single booklet. It is a general description of the botanical features of the islands of Saint Pierre and Miquelon, with a review of the history of the development of botanical knowledge there. After a brief introduction and a geographic description of the islands, the author presents discussions of bedrock geology, the Pleistocene glaciation and its consequences, and an historical summary of botanical exploration. Most of the paper is then devoted to a description of botanical features of the landscape, arranged by localities, with special notes on rare or geographically unusual species. In his discussion of the Pleistocene the author has a good review of the problem of persistence of plants in areas thought to have remained unglaciated. He believes that the islands of the Gulf of St. Lawrence did not suffer greatly from the invasion of Wisconsin ice. The paper is illustrated with

29 text figures, including both maps and half-tone photographs. A supplement contains an enumeration of the marine algae of the islands. Some 58 species are listed, with notes on their local distribution.

H. M. RAUP

HOW TO KNOW THE SPRING FLOWERS. *Pictured-Keys for Determining the More Common Spring-Flowering Herbaceous Plants With Suggestions and Aids for Their Study. Second Edition.*

By Mabel Jaques Cuthbert. Wm. C. Brown Co., Dubuque, Ia. $1.50 (paper); $2.50 (cloth). vi + 194 pp.; ill. 1949.

HOW TO KNOW THE FALL FLOWERS. *Pictured-Keys for Determining the More Common Fall-Flowering Herbaceous Plants with Suggestions and Aids for Their Study.*

By Mabel Jaques Cuthbert. Wm. C. Brown Co., Dubuque, Ia. $1.50 (paper); $2.50 (cloth). iv + 199 pp.; ill. 1948.

These two keys include many of the herbaceous spring- and fall-flowering plants of Southern Canada and the United States or those to be found east of the Rocky Mountains, exclusive of grasses, sedges, rushes, and tropical plants. Some 350 species are included in each key, and there is a good sketch of a portion of each plant, detailed line drawings of certain diagnostic features, as well as fairly accurate distribution maps for each species. Since the spring key includes plants which begin flowering in the spring and continue on into the summer, and the fall key includes species beginning in the summer and blooming on into the fall, one finds many common summer-flowering plants included. The nomenclature is that of *Gray's Manual*, for the most part.

How to Know the Spring Flowers was first published in 1943, but the fall key is a new addition to the Picture-Key Nature Series. The revision of the former is an improvement over the original planographed edition, for it is more attractive, easier to read, more accurate, and there is better coverage of plants in the area designated. Furthermore, distribution maps were not included in the first edition. In spite of corrections, however, some errors still remain such as *coerulea* instead of *caerulea* for the species name of bluets. The teacher and botanist finds the major objection to these keys in the fact that the beginning student or naturalist learns little of relationships of plants within a family or even a genus. It is in a sort of appendix that one finds mention of the plants in a given family. The botanist finds himself somewhat frustrated by finding carpet weed, wild ginger, bastard toadflax, and pitcher plants, as well as some "relatives" in between two species of *Clematis*; and to see composites (in the spring key) preceding creeping snowberry, members of the pea family, figworts, and phlox species is a blow to the student of floral evolution. However, a key is often of necessity only an artificial tool and these keys have their virtue for beginners by including small drawings or diagrams directly in the key itself, so that terms are illustrated where used. The index is also a pictured glossary. For many teachers and students alike the suggestions for plant projects, hints on conserving wild flowers and herbarium making, and lists of state flowers and reference books will prove useful features.

CARROLLE E. ANDERSON

HOW TO KNOW THE WILD FLOWERS.

By Alfred Stefferud; illustrations by Sidney H. Horn. Henry Holt and Co., New York. $2.00. 144 pp.; ill.; frontispiece in color. 1950.

This is a beginner's handbook of common and prominent wildflowers. A brief introduction to descriptive terminology is followed by a treatment of some 100 or more species in layman's terms. It is a useful, though by no means an outstanding book for the interested beginner who wishes to know the plants he encounters. No keys are provided except a color guide on the slip-cover.

C. P. SWANSON

LICHENS AND PARASITES. *B.A.N.Z. Antarctic Research Expedition 1929–1931 under the command of Sir Douglas Mawson. Reports—Series B (Zoology and Botany). Vol. VII.*

By Carroll W. Dodge. Published by the B.A.N.Z.A.R. Expedition Committee and issued through the Barr Smith Library, University of Adelaide, Adelaide, Australia. 60s. (paper). 276 pp. 1948.

Our knowledge of antarctic and subantarctic lichenology has developed slowly, timed to the rare and exploratory thrust by various nationalities into the high southern latitudes; the results have been reported in about 22 papers, some very brief, beginning with the famous voyage of the "Erebus" and "Terror" in 1839–43. About nine of the reports have covered lichenological explorations of the subantarctic islands; 13 have dealt with the lichen flora of Antarctica proper. The present Report (which includes lichen collections of the British Antarctic, 1907–09, and the Australasian Antarctic, 1911–14, Expeditions) of the British, Australian, New Zealand, Antarctic Expedition of 1929–31 provides a most detailed analysis of the lichen flora of little known and previously unreported areas. The author has included additional data upon undetermined Kerguelen Island specimens from the Melbourne Botanical Garden collections and has enlivened the text with a pertinent commentary garnered from a critical survey of the literature and from personal ob-

servation of questionable and historically important specimens from the Tuckerman and T. Taylor collections at the Farlow Herbarium. It is to be regretted that the eventualities of World War II prevented the author from obtaining the loan of types or critical specimens from abroad. Sir Douglas Mawson, member of the first and leader of the two later expeditions, was instrumental in obtaining Dr. Dodge's services for this difficult task, thus assuring the most fortunate preservation of collections that might have suffered the fate of the other botanical specimens destroyed during the London blitz.

Volume 7 of the *B.A.N.Z. Antarctic Research Expedition Reports* is a quarto-, paper-bound publication of 276 pages, illustrated only with a figure of a map of the Antarctic Continent and the subantarctic islands. It includes also two tables listing expeditions to Kerguelia (i.e., Kerguelen, Marion, Crozets, and Heard Islands) and to Antarctica, tabulated as to dates, leaders, ships, collectors, and determiners of their respective lichen collections, as well as locations of the herbaria where the specimens have been deposited. 37 pages are given to the discussion of 8 general localities, itemized as to local data and latitude and longitude; and also including a general account of the geographical distribution with some implications, but no conclusions, regarding areas exclusive of the American sector, which was amply covered in Dodge's and Baker's 1938 report of the botany of the second Byrd Antarctic Expedition. In addition may be noted Sir Douglas' interesting historical preface, the perhaps brief but select bibliography of 36 references, and the complete index. The systematic treatment consists of 230 pages of methodical and detailed descriptions of both gross and microscopic characters, with personal observations (see especially pp. 76 and 83). In all, the author reports on 25 families, 69 genera, and 336 species, not including the 4 families, 5 genera, and 8 species of lichen parasites, of which 3 genera, 95 species, and 4 varieties are described as new, while some 36 new combinations are proposed. 4 sterile and fragmentary thalli are reported as "undeterminable"! Not only is this work, except for the aforementioned publication of 1938, the largest volume yet to appear on antarctic and subantarctic lichenology, but it marks the readvent of American thought in an area in which Europeans have long excelled. With the exception of Tuckerman, few if any other Americans have had the opportunity or necessary background prerequisite for such an arduous and exacting undertaking. Inasmuch as C. W. Dodge has undertaken the determination of lichens from all parts of the world, it would not be amiss to refer to him as our senior lichenologist. Americans are also fortunate that this type of research provides at the Missouri Botanical Garden for the development of a fine antarctic collection.

Throughout the text, keys are available to families, genera, and species; families and genera are preceded with brief but satisfactory introductory descriptions. Larger genera are divided into sections, as in the case of *Cladonia* and *Parmelia*. *Buellia* and *Lecidea*, both consisting of many species, are conveniently separated into geographical keys. The genus type is always stated, and in questions of doubt is annotated with relevant remarks; synonyms are cited where necessary. The treatment is extremely scholarly, almost monographic. Notes on substrate, chemical reactions, unusual morphological structures or sequences, as given, for example, for *Cladonia phyllophora* (pp. 132–134), provide stimulating data and reflect the meticulous and logical methods of the author.

In the absence of type material, Dodge had no alternative but to rely on the published descriptions of species described as new by earlier antarctic workers. In this task he was most persevering, aided in great part by the excellent facilities of the Missouri Botanical Garden Library as well as by the systematic accumulation of records he has maintained on 3 x 5 cards since the last (1940) published volume of Zahlbruckner's *Catalogus*. This method is not always desirable and shows its disadvantage clearly in the example of the genus *Charcotia* Hue, which Dodge has extended; while at the same time Lamb, by examining the type in Paris, has shown it to be a *nomina confusa*. Undoubtedly some of these species may in the future be reduced to synonomy by monographers, specialists, or whoever will be fortunate enough to bring all the materials together for final clarification. Dodge's problem was a difficult one, and he has met it in a direct manner. Rather than bury the specimens under old and tried names or refer them provisionally to accepted species, as was the custom among the older systematists, he has singled them out for individual attention. In the case of *Peltigera*, he cites the 2 specimens only to genus, giving all characters possible, and then summarizes all previous records of this genus by other workers in the Subantarctic. This conservative action would not be appreciated by those who have rushed in with a multitude of new species, varieties, and forms for this difficult genus. Where material has been fragmentary or impossible to determine for other reasons, he cites the locality and substrate, taking it only to genus. In all cases the specimens are clearly identified for the purposes of his report. Those who may question his decisions will be aided, in a large part, by the firm and open manner of presentation. This is a milestone in American lichenology.

GEORGE A. LLANO

DRAWINGS OF BRITISH PLANTS, *Being Illustrations of the Species of Flowering Plants Growing Naturally in*

the British Isles. Parts I–III: Ranunculaceae to Cruciferae.

By Stella Ross-Craig; with a foreword by Sir Edward Salisbury. G. Bell & Sons, London; British Book Center, New York. Part I: 6s.; Part II: 4s. 6d.; Part III: 9s. Part I—Ranunculaceae: 44 plates; Part II—Berberidaceae, Nymphaeaceae, Papaveraceae, Fumariaceae: 22 plates; Part III—Cruciferae: 77 plates. 1948–1949.

Parts I and II of these drawings have already been mentioned in previous reviews (*Q.R.B.*, 25: 224). They were published separately, Part I containing the Ranunculaceae and Part II the Berberidaceae, Nymphaeaceae, Papaveraceae, and the Fumariaceae. In the present volume Part III, the Cruciferae, is added and all are bound together, with an index to the whole. In all there are 143 plates. The drawings are superbly made and beautifully printed.

HUGH M. RAUP

PLANT MORPHOLOGY

THE NATURE OF THE INFERIOR OVARY IN THE GENUS BEGONIA. *Contributions de l'Institut Botanique de l'Université de Montréal—No. 66.*

By Roger Gauthier. Institut Botanique de l'Université de Montréal, Montréal. 50 cents (paper). 91 pp.; ill. May 1950.

ECONOMIC BOTANY

LE LIVRE DES PLANTES MÉDICINALES ET VÉNÉNEUSES DE FRANCE. *1,500 Espèces. Par le Texte et Par l'Image; d'Après l'Ensemble de nos Connaissances Actuelles.*

Tome I. Abricot à Coloquinte. Encyclopédie Biologique XXV.

Tome II. Consoude à Melon. Encyclopédie Biologique XXXI.

Tome III. Menthe à Zacinthe. Encyclopédie Biologique XXXII.

By P. Fournier; preface by Henri Leclerc. Paul Lechevalier, Paris. (I) 800 fr. (paper). (II) 1,250 fr. (paper). (III) 2,600 fr. (paper). (I) lxxviii + 448 pp.; ill. (II) 504 pp.; ill. (III) 637 pp.; ill. (I) 1947; (II & III) 1948.

P. Fournier, author of several taxonomic works dealing with the French Flora, has now written an exhaustive treatise on the medicinal and poisonous plants of France. Fournier's three volumes are somewhat similar to the Italian work by Negri, published by Hoepli, but is different in the distribution of the subject matter, It is essentially an encyclopedic, botanico-pharmaceutical monograph, and, as such, is a scholarly and commendable accomplishment and a valuable addition to the literature.

The pharmacological and strictly medical discussions are general rather than critical in nature, but constitute a good summarization for reference purposes. Although the title refers to the plants of France, Fournier's work will actually serve well for the Central European area in general. In addition, since many of the important botanic drugs in world-wide use are treated, Fournier's volumes will be a valuable acquisition to the libraries of all Colleges of Pharmacy and Departments of Pharmacology in Colleges of Medicine, wherever research in the field of botanic drugs is in progress. These volumes are clearly written and present 1500 species, arranged alphabetically by their common names as in a dictionary. Latin names (genus, species, authority) are given in accordance with the Linnaean Law of Binomial Nomenclature and the Law of Priority and in general agree with the International Rules of Nomenclature. Over 800 carefully drawn illustrations are most helpful in the identification of species, in conjunction with the usual Keys.

Volume I has an interesting introduction which includes a history of phytotherapy and considers the role that plants have played in homeopathy and in medical theory and practice in general, especially in pharmacy and pharmacology. The subject of plant alkaloids and glucosides and the effects of active plant principles is summarized. The botanical classification (in Latin) of the medicinal flora of France is followed by a Key to the plant groups involved. Volume I presents Abricot (Apricot, *Prunus armeniaca* L.) through Coloquinte (*Citrullus coloeynthis* Schrad.), with 347 figures.

Volume II presents Consoude (*Symphytum* (Tourn.) L.) through Melitte (*Melittis melissophylium* L.), with 215 figures. Volume III presents Menthe (*Mentha* (Tourn.) L.) through Zacinthe (*Zacintha verrucosa* Gaertn.), with 256 figures. Volume III also includes a useful, brief bibliography under such captions as Floras, Botanical Theory, and History, and a more extended reference list of over 30 French and German authors who have worked in the field of phytotherapy. There is also a classification of over 100 categories of the medicinal plants mentioned in all three volumes arranged alphabetically according to pharmacodynamic action. This is followed by an alphabetic, therapeutic list of approximately 300 illnesses and the plants employed for their alleviation. Obviously the applied, medicinal phases of Fournier's work are not critical nor completely up to date in terms of any current official pharmacopoeia, being a compilation that includes many species not used by any modern School of Medicine. Volume III terminates with three separate, useful indices, each arranged alphabetically, and listing the French names, the Latin names, and the Common names.

Each species discussed in the text of these three volumes is typically treated under the following captions: Botanical description; History; Properties; Uses; Chemical Principles; Toxicity; and Physiological Ac-

tion. In the case of many significant species, for example, such linnaean species as *Aconitum napellus, Atropa belladonna, Colchicum officinalis, Digitalis purpurea*, etc., a still more detailed presentation has been given. This includes methods of cultivation and harvesting, special uses, and posology in modern medicine; and, in a few instances, the cellular action is stated. For example, under *Colchicum*, the effect of colchicine on chromosome behavior is cited. Because of the inclusion of some material of general biological significance, plant chemists, plant cytologists, and cellular physiologists concerned with materia medica and cellular pharmacology will find portions of Fournier's work a useful reference.

RALPH HOLT CHENEY

THE NON-PARASITIC DISORDERS OF APPLE FRUITS IN AUSTRALIA. *Bulletin No. 238, Council for Scientific and Industrial Research, Commonwealth of Australia.*

By W. M. Carne. Council for Scientific and Industrial Research, Melbourne, Australia. Free upon request (paper). 83 pp.; 24 plates. 1948.

THE USE OF AGRICULTURAL SOIL MAPS AND THE STATUS OF AGRICULTURAL SOIL MAPPING IN THE UNITED STATES. *Highway Research Board, Bulletin No. 22. Presented at the Twenty-Eighth Annual Meeting, 1948.*

Contributors: Frank R. Olmstead, L. D. Hicks, and Goeffrey B. Bodman. Highway Research Board, Division of Engineering and Industrial Research, National Research Council, Washington, D. C. $1.80 (paper). iv + 128 pp.; ill.; geologic map of North Carolina. 1949.

HOME ORCHID GROWING.

By Rebecca Tyson Northen. D. Van Nostrand Co., Toronto, New York, and London. $6.00. vi + 286 pp. 1950.

ORCHIDS AND HOW TO GROW THEM.

By Adelaide C. Willoughby. Oxford University Press, New York. $3.50. xii + 135 pp. + 17 plates. 1950.

The publication of two books in this highly specialized and select field of gardening is indicative of the fact that some of the mysteries of successful culture have been reduced to a formula which can be followed by anyone who has the patience to do so. Mrs. Northen goes further to point out that the conditions of successful culture can be obtained in the home, eliminating in this way the one obstacle, access to a greenhouse, which most individuals feel to be a necessity beyond the reach of their pocketbooks. Both books provide adequate information as to methods of culture and propagation, as well as lists of species and hybrids which are easy or difficult of culture. Collector's items are also discussed for those who would go beyond the culture of the usual species. While both volumes convey enthusiasm in an infectious and typically feminine manner, that by Mrs. Northen is the more complete in context and illustration. In addition to the more general cultural practices, she provides sound information on the possibilities of hybridization (even to explaining the genetics of flower color, and the use of colchicine for inducing the formation of tetraploids), and on the techniques and art of cut flower and corsage arrangement. Either volume, however, will furnish the reader with the desired knowledge of orchid culture.

C. P. SWANSON

THE GRAFTER'S HANDBOOK.

By R. J. Garner. Oxford University Press, New York (printed in England). $4.00. 223 pp.; ill. 1949.

The art of grafting has been a popular subject for dissertation by horticulturists since ancient times, but it is doubtful if any writer on this subject has prepared such a clear and concise description of grafting techniques as those treated here. Detailed instructions are provided not only for most of the important methods of grafting, but in addition such related problems as the propagation of rootstocks by seed and asexual methods, the collection and storage of scion-wood, and the selection and use of proper tools are given careful, up-to-date treatment. The author is a well qualified specialist in the field of plant propagation, with more than 20 years' experience at England's internationally respected East Malling Research Station. The book is illustrated with 95 line drawings and 24 pages of halftones, all of excellent quality. This book will be a valued addition to the library of the professional or amateur horticulturist.

SCOTT S. PAULEY

SUGAR. *Its Production, Technology, and Uses.*

By Andrew Van Hook. Ronald Press Co., New York. $3.00. x + 155 pp.; ill. 1949.

The author, a professor of chemistry at Holy Cross, has contributed this volume to the Humanizing Science series in the hope that it will "bring together in readable and understandable form the essential facts about the growing, processing, and refining of sugar, the scientific basis of its technology, and its many and diverse uses—both present and potential."

Chapter I deals with the chemistry of sugars; chapters II and III discuss the production of cane and beet sugars; chapter IV surveys the commercial and trade aspects of sugar; chapter V is concerned with by-products; and chapter VI reviews the history of sugar

utilization. The entire discussion is extremely elementary but highly readable. The pictures and tables are excellent, the typography is impeccable, but the lack of a bibliography distressing.

In general, I can see no real reason for buying this book for essentially the same information is available without charge in the attractive pamphlets published by the Sugar Research Foundation, New York. It does, however, deserve a place on reference shelves.

ARTHUR W. GALSTON

MANUEL DE PHYTOPHARMACIE. *Tome I. Généralités—La Phytopharmacie et le Pharmacien—Dégats Occasionnés et leur Valeur Pour la Détermination des Ennemis des Cultures. Législation—Textes Officiels et Critiques.*

By Émile Perrot and René Fabre. Masson et Cie., Paris. 850 fr. (paper). iv + 618 pp.; ill. 1948.

MANUEL DE PHYTOPHARMACIE. *Tome II. Les Parasites ou Déprédateurs Animaux. Les Parasites d'Origine Végétale.*

By G. Valette and R. Cavier; L. Lutz. Masson et Cie., Paris. 650 fr. (paper). iv + 368 pp.; ill. 1948.

MANUEL DE PHYTOPHARMACIE. *Tome III. Les Produits Utilisés en Phytopharmacie (chimie, pharmacologie, toxicologie). Pratique des Traitements et Maîtriel en Usage.*

By René Fabre and Yves Raoul; A. Desrue. Masson et Cie., Paris. 900 fr. iv + 409 pp.; ill. 1949.

From the title of this work, the American pharmaceutical educator and student might expect the contents to be quite different from what one actually finds in the 3 volumes.

Volume I stresses the part which pharmacy can play in serving agriculture. A general consideration is given to various economic plants, and to the animal and plant parasites which attack them. Some of the plants considered are asparagus, the sugar beet, various cereal grains, certain crucifers, the potato and other solanaceous plants, forest and fruit trees, grapes, and numerous ornamentals. Even the storage of potatoes is considered, as is the protection of certain forms of beneficial animal life. One chapter includes a consideration of the usefulness of certain plant materials such as nicotine, pyrethrum, rotenone, and red squill in pest control. Much of the subject matter of this volume is concerned with phytopharmaceutical legislation.

Volume II is concerned with a rather detailed consideration of certain harmful organisms such as nematodes, insects, pathogenic fungi, viruses, etc. Descriptions, types of damage caused, and methods of control are included. Numerous figures constitute a part of this volume.

Volume III deals with the products utilized in what the authors choose to call "phytopharmacie." This information is perhaps the most useful in any of the 3 volumes. Adjuvants, insecticides, fungicides, and herbicides are among the pesticides considered. Both recently developed and older pest-control materials are included. The coverage of these substances is quite complete, and one whose work is concerned with economic poisons might well make good use of the information available in this volume. Rather detailed consideration is given to types of equipment used in applying sprays, dusts, etc. This portion of the work is well illustrated by figures.

These volumes by Perrot and his co-workers will undoubtedly find a place in the libraries of American educational institutions, particularly in colleges of agriculture and perhaps in colleges of pharmacy. Certainly the pharmaceutical curricula in this country should more often contain courses dealing with this subject. There does not seem to be any work written in English which assembles the same material as is to be found in the *Manuel de Phytopharmacie.*

MAYNARD W. QUIMBY

TWENTY-YEAR PROGRESS REPORT 1928–1948. *The Black Rock Forest. Bull. No. 14.*

By Henry H. Tryon and Raymond F. Finn. Cornwall Press, Cornwall-on-the-Hudson, New York. $2.50 (paper). iv + 89 pp.; ill. 1949.

The Black Rock Forest, located in the Hudson Highlands of New York State, was until recently a privately owned and endowed forest research station which had been under the continuous direction of the senior author of this report since 1927. The results and pertinent implications of the work here summarized have particular significance for silviculturists and ecologists interested in the eastern hardwood types of forest. In a larger sense, it is of special interest to all foresters because it reflects an all too rare insight and appreciation for the factual basic data upon which modern silvicultural practice must eventually be established. The authors' stress of this point appears frequently throughout the discussions. It is well that it does, for it may serve to forewarn others that although the solution of silvicultural problems by intuition may be expeditious in the exigencies of the present, intuition is a frail substitute for recommendations based on statistically verified silvic data.

The report is well organized and clearly written. Aside from the several tables scattered throughout the text, the report is illustrated by a number of halftones of fair quality. A preliminary reading of the *Ten-Year Progress Report 1928-1938* (Black Rock Forest Bulletin 10. 1939; cf. *Q.R.B.*, 15: 248) will be found

helpful to the prospective reader: in any case a copy should be available for reference.

SCOTT S. PAULEY

APPLIED SILVICULTURE IN THE UNITED STATES. *Second Edition.*

By R. H. Westveld. John Wiley & Sons, New York; Chapman & Hall, London. $6.00. xii + 590 pp.; ill. 1949.

The second edition of this valuable text and reference book represents, like the first, a welcome summary of currently popular American silvicultural practices. The general arrangement of material follows closely the highly commendable method employed in the first edition, i.e., the treatment of silvicultural problems in the United States by forest regions rather than by silvicultural systems. This method not only has practical pedagogical merit, but provides the practicing forester with a quick and authoritative précis of regional forestry problems.

The principal objective of the new edition has been to bring the discussion up to date by including the results of silvical and silvicultural research which have accumulated during the 10 years since the first edition. Whether some of these results, as well as many previous ones, have materially contributed to the clarification of certain fundamental silvicultural problems in the United States appears doubtful. The tendency to mix small quantities of verified fact with outsized portions of speculation by intuition appears to be popular with investigators in this and some related fields. The circumstances do, however, admit some latitude in this regard, since the practice of silviculture is admittedly an "art." As such, individual tastes and interpretations of the factual or fictional background may apparently be determined largely by the temperament of the practitioner.

Forest-tree nomenclature and forest-type classification have been revised to conform with currently acceptable ideas in these matters. Also, data on prices, costs, and profits have been changed from the monetary values employed in the first edition to the more practical expression of these items in terms of man-hours or ratios to show relative values.

SCOTT S. PAULEY

FOREST PRODUCTS. *Their Sources, Production, and Utilization. The American Forestry Series.*

By A. J. Panshin. E. S. Harrar, W. S. Baker, and P. B. Proctor. McGraw-Hill Book Co., New York, Toronto, and London. $6.00. x + 549 pp.; ill. 1950.

The wide and varied experience of the authors, together with the source material indicated and the considerable list of industrial and professional specialists whose cooperation is acknowledged assures the reader of this book of authoritative, up-to-date information. The authors aim to stress basic concepts and areas of utilization rather than to present detailed cost and statistical data of only transitory value. They liken this textbook to a pair of crutches which will assist the tyro until he can walk alone in his chosen field. It presents in concise form information on origin, methods of conversion, and utilization of the principal primary and secondary forest products.

The book is divided into 4 parts of very unequal length. The first part, about 50 pages in length, contains 3 chapters related to the economics of forest utilization—resources, residues, and general properties. Each chapter is followed by excellent lists of selected references useful to those who desire to go deeper into aspects not fully treated here because of space limitations. Part II, Wood Products, is the largest (over 200 pages) and covers the long known and used wood products in 11 chapters: timber, ties, veneer, fuel, etc. Chemically derived products are treated in 5 chapters (over 100 pages) in Part III. Pulp and paper, insulation materials, cellulose filaments and film, carbonization, destructive distillation, and wood saccharification are grouped together. In the 5 chapters (110 pages) devoted to other derived and miscellaneous products in Part IV is to be found some of the less generally available, recent information on naval stores and maple sirup production, together with data on sources of tannins and dyes, information on wood in plastics and minor forest products such as barks, oils, and resins, nuts, Spanish moss, pine needles, redwood-bark fiber, and forest products for Christmas trees and greens. Of the more than 100 well-chosen illustrations the greater number (62) are used in the chapters on wood containers, pulp and paper, naval stores, and veneers and plywood. The illustrations are numbered separately in each chapter. Complicated conversion processes are presented in the form of flow charts. The value of the book is greatly enhanced by a 22-page index.

ELOISE GERRY

SURINAME TIMBERS I. *General Introduction, Guttiferae, Vochysiaceae, Anacardiaceae, Icacinaceae. Publications of the "Natuurwetenschappelijke Studiekring Voor Suriname en Curaçao," Utrecht. No. 3.*

By Alberta M. W. Mennega. Martinus Nijhoff, The Hague; Foundation for Scientifical Research in Suriname and Curaçao, Utrecht. f 7.50 (paper). 60 pp. + 8 plates; text ill. 1948.

The decreasing timber resources in the world's temperate regions have made it more and more necessary to

examine the abundant timber potential in the forests of tropical America. However, one of the big problems in the efficient exploitation of tropical forests is the heterogeneity of species in any given stand. The species of known commercial value are represented usually as individuals widely scattered among a host of associated species, whose timber value often is considered worthless but might better be called unknown. There is great need for a careful stocktaking of the potentially important tree species in Latin America, especially when consideration is given to the new technical methods recently introduced for the use of timbers.

The commercial timbers of Suriname probably are better known than any other tropical South American country, thanks to the work of Pfeiffer (1926), but with the increasing knowledge of the flora of Suriname new potentially important timbers have become known and require study. Miss Mennega here presents the first of a projected series of technical papers reporting on the anatomy of Suriname timbers. Since many of these trees occur elsewhere in Latin America, the paper is not of mere local interest. The work is based principally on a large and representative collection of wood samples, with accompanying herbarium specimens made during the recent war by Professor Stahel of Paramaribo. Miss Mennega has included a description of the anatomical characteristics of each of four families, as well as descriptions of and keys to the woods of certain species of the following genera: *Caraipa, Vismia, Calophyllum, Clusia, Tovomita, Rheedia, Platonia, Symphonia, Vochysia, Qualea, Erisma, Anacardium, Loxopterygium, Spondias, Tapirira, Poraqueiba, Dendrobangia,* and *Discophora.*

W. H. HODGE

MANUAL OF BACTERIAL PLANT DISEASES.

By W. J. Dowson. Macmillan Co., New York. $2.50. viii + 183 pp. + 32 plates; text ill. 1949.

This excellent textbook, written by an authority who is a plant pathologist, mycologist, and bacteriologist, gives a general account of all bacterial diseases of plants occurring in Great Britain, the more important ones in the British Empire, and a few of the diseases that are confined to America. The symptoms and etiology of each disease are covered, with control methods in all cases in which suitable ones are known. The methods of investigation, the preparation of cultural media, and the identification of bacterial plant pathogens, are also described. Chapter 1, General Characters of Bacteria, and Chapter 2, Classication and Nomenclature, although occupying less than 12 pages, are an excellent introduction to basic bacteriology. Some 50 pages are devoted to types of disease symptoms, methods of investigation, and bacteriological techniques. Chapters 8 to 11, inclusive, cover the diseases caused by the respective genera of plant pathogens, *Corynebacterium, Pseudomonas, Xanthomonas,* and *Bacterium.* Diseases caused by miscellaneous genera are described in Chapter 12. Half-tone illustrations of bacteria and diseased plants occupy 32 pages. The world distribution of the principal bacterial diseases of plants is illustrated in 18 full-page maps. This is the only up-to-date book available on the general subject of the bacterial diseases of plants. References to literature follow each topic discussed. The book should find a place on the reference shelf as well as in the classroom.

J. H. MARTIN

OUR ROSE VARIETIES AND THEIR MALMAISON HERITAGE.

By Edwin DeT. Bechtel. New York Botanical Garden, New York. $1.00. 20 pp.; ill. 1949.

To all rose growers and those interested in the historical development of our modern roses the small booklet entitled *Our Rose Varieties and Their Malmaison Heritage* will be a welcome addition to rose lore.

The genus *Rosa,* which is older than the Ice Age, is widely distributed throughout the northern hemisphere. Originally the genus was divided by Linnaeus in 1762 into 14 species. In 1820 Lindley divided it into 11 sections or types, with 26 subdivisions. More recently M. Crépin, formerly director of the Brussels Botanical Garden, has divided the genus into 15 sections with 55 species. In 1947 McFarland, in *Modern Roses III* adopted a classification of 296 species. As prepared by Rehder of the Arnold Arboretum, this classification lists as separate species 3 *Rosa alba,* 6 *Rosa carolina,* 7 *Rosa chinensis,* 3 *Rosa damascena,* and 6 *Rosa gallica.* He also divided the Tea Rose (*Rosa odoranta*) into 5 species. The roses so classified are the simpler wild roses and do not include our complex and numerous hybrid roses of today, which comprise more than 16,000 varieties. The Hybrid Teas, Hybrid Perpetuals, and Hybrid Polyanthas are not found in the botanies. Most of our twentieth century roses are Hybrid Teas, and very few of our nineteenth century roses antedate 1870.

Rose culture today owes much to the patronage of the Empress Josephine and to those who designed and executed her famous rose garden at Malmaison. From 1799, when Bonaparte purchased Malmaison for Josephine, until her death in 1814, the chateau was enlarged and embellished. The parks and gardens were developed after the plan of an English garden by the Scotch horticultural expert, Thomas Blaikie. An English gardener, Howatson, the botanist Ventenat, and the horticulturalist André Dupont also employed their talents in developing and growing the rare plants and seeds

which under Josephine's patronage were collected from all over the world. Before her death in 1814 Josephine had caused to be planted 184 new plants and shrubs at Malmaison. These were described by Thory and illustrated by Redouté in the well known volume, *Jardin de la Maison*. It was, however, the rose garden which drew most of Josephine's attention. While the exact number of rose varieties in her garden is not known, a conservative estimate of 197 has been given by Jules Gravereaux in his monograph *Les Roses de la Malmaison*, published in Paris in 1912. Among the roses in Josephine's garden which are of special interest, Gravereaux lists 107 varieties of Gallica, 27 Centifolia, 3 Moss Rose, 9 Damask, 22 Bengal or China Rose, 4 Scotch Rose, 8 Alba, one Musk; as well as the species roses *alpina*, *carolina*, *cherokee*, *rugosa*, and others. Many of these are illustrated in Redouté and Thory's *Les Roses*.

Under the patronage of Josephine many new varieties were developed. By hybridizing and artificial pollination the horticulturalist Dupont originated 25 new varieties, and Descemet about 80. In Josephine's time most of the earliest Gallicas were of solid colors, varying from pinks to deepest shades of crimson. Soon growers brought into existence bizarre striped, spotted, and mottled varieties and numerous beautiful Agathas, many of which persisted until the first decade of the present century. Following Josephine's death the garden fell into disuse and many of the roses disappeared. Prince Eugene sold Malmaison to a Swedish banker, who in 1848 sold it to the Queen of Spain. In 1861 Napoleon III bought it for a museum. During the war of 1870 the garden was destroyed and the chateau damaged. In 1896 the French philanthropist, M. Jean Osiris, bought the property and presented it to the French government. Many donors contributed to its restoration as a memorial. Through the research of Jules Gravereaux, the rose garden was reestablished in 1911 as a memorial to Josephine. Planted there are to be found the dozen species known in Josephine's time and about 40 of the Centifolia, Moss, and Damask; together with 20 types of Bengals and 100 Gallica derivatives. A number of strains of these roses may be seen in the New York Botanical Rose Garden. While many rose gardens existed in France in Josephine's time, her contribution to rose culture was extraordinary. Her ambition as a patron, her exacting requirements as a collector, and her stimulus to the development of new varieties fostered the rehabilitation and renaissance of rose culture.

EMILY E. TRUEBLOOD

HANDBUCH DER DROGENKUNDE. *Erkennung, Wertbestimmung und Anwendung. Band 1. Untersuchungsmethoden, Cortices-Flores.*

By Franz Berger. Wilhelm Maudrich, Wien. $10.00. xii + 402 pp.; ill. 1949.

In addition to a consideration of barks and flowers, this volume by Berger gives 70 odd pages of space to investigational methods as applied to plant materials. Included are discussions of botanical, physical, chemical, and biological methods, and microsublimation. This is perhaps the most valuable part of the entire volume.

Consideration is given to about 60 different medicinal, and otherwise economically important barks (*Die Rinden*), arrangement being alphabetically by latinized names. Included with the "true" barks are the rinds of a number of fruits, among them certain citrus peels and rind of the pomegranate fruit.

Numerous drawings and photographs illustrate the external appearances and histological features of many of the items considered. While most of the drawings are well done, certain others could have been improved upon. Parts used, botanical sources, descriptions of macroscopic and microscopic features, and constituents are considered in the various monographs. In many cases uses and dosages are included. Chemical consideration is given to certain constituents.

Approximately 60 economically important flower clusters, flowers, and flower parts are included following a general consideration of flower structure. The numerous line drawings and photographs are better than some of the illustrations included in that portion of the book dealing with barks. Very few of the figures have to do with floral histology. Information concerning each item in this section of the book is of the same type as that included for the barks.

The final 38 pages of the volume are given over to the inclusion of more than 500 literature citations, a glossary of medical terms, and the index.

Those whose work is concerned with the investigation of medicinal barks and flowers should find this book useful as a reference work.

MAYNARD W. QUIMBY

FORAGE CROPS. *McGraw-Hill Publications in the Agricultural Sciences.*

By Gilbert H. Ahlgren. Consulting Editor: R. A. Brink. McGraw-Hill Book Co., New York, Toronto, and London. $5.00. x + 418 pp.; ill. 1949.

The author's stated purpose with this book was to fill "an important need for a modern textbook in forage crops." With his statement of the need, there can be no argument. This highly-important and fast-growing subject has not been covered similarly during the past 25 years. Likewise, there should be little question about the author having accomplished his purpose.

The book is well organized for use as a text. Following the first three chapters that are devoted to history and development, statistics of production, and in-

fluence of climate and soil, the next 19 chapters enlarge on the details of individual crops. Here much pertinent information is summarized under such subheadings as adaptation, varieties, cultural practices, and feeding value. The remaining 19 chapters cover many general subjects on forage crops, such as identification, seeding mixtures, companion crops, hay standards, saving labor, silage, grassland farming, diseases and insects, plant breeding, and seed production. Many of the 99 text figures (photographs, maps, graphs and drawings) are original and serve well to illustrate important points.

In many respects the book will serve also as a reference for research agronomists who now are so specialized that it is difficult to keep abreast of developments even in this narrow field. The facts are well organized for reference purposes also, since most of them are presented in the 393 tables that were carefully chosen to emphasize the principal conclusions. Most tables have been copied from the original research articles and bulletins, and these together with the references at the end of each chapter constitute a good outline for anyone wishing to study the details more thoroughly.

The title of the book may be somewhat misleading. The author has restricted the term forages to "those crops harvested by man and later fed to livestock." This term is now commonly used by others to include pastures as well as hay and silage, and most of the species that are considered in the book likewise have such multiple uses. Discussion of the cultivated species is more exhaustive than that of the native range species, and here also some readers may expect more than has been included. To cover these other subjects completely, however, would have made the book more extensive and reduced its usefulness as a text for the usual single-semester course.

SANFORD S. ATWOOD

THE HISTORY AND SOCIAL INFLUENCE OF THE POTATO. *By Redcliffe N. Salaman; with a chapter on Industrial Uses by W. G. Burton. Cambridge University Press, New York and London.* $10.00. xxiv + 685 pp. + 33 plates; text ill. 1949.

This book is a distinguished contribution to the literature on the plants which nourish mankind. The author has spent more than 40 years in research upon the genetics, morphology, and pathology of the potato and in his later years augmented these with a study of the social and economic reactions ensuing from the adoption by the masses of a cheap, efficient, and easily produced foodstuff. This unique approach has resulted in a scholarly and fascinating treatise which is of interest not only to botanists and horticulturists but also to historians and sociologists.

The history of the potato is traced back to its beginnings in the highlands of South America. There, primitive man, who had made his way eastward from the lowlands, was enabled to maintain himself at high altitudes through the cultivation of the potato which became his principal food plant. The importance of the potato to the prehistoric peoples of Peru and the adjoining countries of South America is attested by a wealth of archaeological remains, principally pottery, in which the tuber is represented, sometimes quite realistically, sometimes with curious anthropomorphic symbolisms.

Botanical researches by the author and his colleagues indicate that the cultivated potato, ***Solanum tuberosum***, is actually a form of ***S. andigenum***, a forty-eight chromosome polyploid species which arose through the chromosome doubling of ***S. stenotomum*** and perhaps other species in the region of Lake Titicaca. Forms of ***S. andigenum*** resembling ***S. tuberosum*** occur at the fringes of its range in Chile and Colombia. The Russian botanists believed that the European potato came from Chile. Dr. Salaman makes an excellent case for a Colombian derivation.

Once introduced into Europe, the adoption of the potato met with considerable opposition from the common people for a great variety of reasons: it was not mentioned in the Bible; it was the first edible plant to be grown in Europe for its tubers; its flowers resembled those of the deadly nightshade; it was confused with the sweet potato which supposedly was dangerously lust-inducing; during the period when the fabulous Doctrine of Signatures prevailed, the rough scurfy skin of the potato called to mind such diseases as leprosy. But in spite of prejudices and suspicions the potato gradually became an important food plant, partly because it was a "heaven-sent gift" to industrialists eager to find cheap living for cheap labor engaged in producing cheap goods.

More than half of the book is devoted to the history of the potato in Ireland, Scotland, Wales, England, and the Channel Islands. Its history on the Continent is, regrettably, barely touched upon. Of particular interest are the chapters on the potato in Ireland. Ireland was the only country where the new crop spread naturally and quickly became the principal food of the masses. In Ireland it eventually brought disaster. There were numerous failures of the potato crop in Ireland in local areas but the universal failures of 1845 and 1946 caused famine followed by scurvy, dysentery, cholera, and typhus. There had been no disaster so acute since the Black Death. The famine was followed by a wave of emigration from Ireland to America. The atmosphere in which American, Irish, and English relations were to develop for the next hundred years was determined in a large part by the failure of the potato crop in these two critical years and by the widespread distress and animosity which followed. The author concludes in a brief epilogue that "After proving itself the most perfect instrument for the maintenance of poverty and degradation amongst the native masses, the potato ended in wrecking both exploited and exploiter."

There is an interesting final chapter on the potato in the realm of art which complements an earlier chapter on the archaeological record. The book contains several useful appendices and the most comprehensive bibliography yet published on the potato.

PAUL C. MANGELSDORF

PLANT PHYSIOLOGY

PHOTOSYNTHESIS IN PLANTS. *A Monograph of The American Society of Plant Physiologists.*

Edited by James Frank and Walter E. Loomis. Iowa State College Press, Ames. $7.00. x + 500 pp. + 5 plates; text ill. 1949.

Included in this monograph are 22 papers dealing with various phases of photosynthesis, some of which were written especially for this volume and others presented at the symposium for photosynthesis held at the Chicago meeting (1947) of the A.A.A.S. As such, its varied contents represent well the lines along which current research in the field is developing. The problems are clearly brought out and the various research methods described. Plant physiologists and workers in diverse fields will find much of current interest in this monograph with some articles of more than passing significance.

An introduction by W. E. Loomis is followed by articles on field studies of photosynthesis in crop plants (M. D. Thomas and G. R. Hill) and the kinetics of diffusion through pores (J. Verduin). The remaining chapters fall largely into three categories, the first of which includes five papers on the chemical and physical properties of the photosynthetic apparatus, the chloroplast pigments in particular (S. Granick on chloroplasts, H. H. Strain on the nature and properties of chloroplast pigments, R. Livingston on the photochemistry of chlorophyll, P. Rothemund on the synthesis of chlorophyll, J. H. C. Smith on chlorophyll formation *in vivo*).

Physical studies on the overall photosynthetic reaction constitute a second group. Quantum efficiency measurements are reported here in detail by workers from four laboratories using three different methods (manometric: R. Emerson and M. S. Nishimura, F. F. Rieke—polarographic: W. E. Moore and B. M. Duggar —calorimetric: W. Arnold). All report requirements for at least 8 quanta per O_2 molecule evolved, findings which have since been challenged by O. Warburg and coworkers, who claim new evidence for a requirement of four quanta. Chlorophyll fluorescence and its relation to photosynthesis are considered in articles by J. Franck and E. Katz.

The third category of papers deals with the biochemical aspects of the photosynthetic reaction. The earlier findings by tracer methods are amplified by M. Kamen. The California group (A. A. Benson, M. Calvin, and co-workers) and the Chicago group (A. H. Brown, E. W. Fager, and H. Gaffron) report some of their preliminary contradictory findings on the nature of the early intermediates. Other articles cover the overall features of metabolism in *Chlorella* (J. Myers), the nature of photosynthetic products (J. H. C. Smith), and reactions of isolated chloroplasts (A. S. Holt and C. S. French). Fittingly the volume is concluded with an article on the comparative biochemistry of photosynthesis by C. B. van Niel, whose own work on the bacterial photosyntheses is sufficient testimony to the fruitfulness of this approach.

FRANCIS HAXO

GENERAL AND SYSTEMATIC ZOOLOGY

DETERMINATION OF THE FAUNA AND FLORA OF THE NORTHERN SEAS OF USSR.

Edited by N. S. Gayevskaya. State Publishing House "Soviet Science," Moscow. 26 rubles. 740 pp. + 136 plates; text ill. 1948.

This is a handbook of the marine invertebrates and plants of the Arctic seas of Russia, and, although printed in Russian (except for scientific names), should be called to the attention of American marine biologists concerned with the fauna of the arctic and high boreal regions. Many of the species listed are to be found as far south as Cape Cod and Puget Sound. Keys are provided for each group, and almost every species mentioned is illustrated by clear line drawings. Fourteen specialists have joined to produce this work, the first comprehensive treatment of the life of the arctic seas. Those who have even less than my knowledge of Russian should find the illustrations of value and be able to use the book in a limited manner. The paper stock is excellent for a Russian book, but the binding is flimsy for a book of this size.

JOEL W. HEDGPETH

ZOOLOGICAL TECHNIQUE *for Teachers and Senior Students. Second Edition (4th Impression).*

By T. L. Green. Allman & Son, London. 7s.6d. 118 pp. + 3 plates; text ill. 1946.

This little manual is designed particularly for graduate students and teachers who have to do much of their own laboratory preparation. The first section describes methods for collecting, culturing, dissecting, anesthetizing, killing, staining, injecting, etc., 17 common invertebrates and 5 vertebrates, including most of the forms studied in American high school and college courses in General Biology, General Zoology and Comparative Anatomy. Some directions for observations and simple experiments on the living animals are also included. The next two sections outline histological fixation, staining and sectioning procedures, including numerous

practical hints and "trouble shooting" reminiscent of Guyer's "Animal Micrology." The section on Museum techniques covers jars, labels, sealing, preserving, preparation of skeletons, models and casts, and glass-cutting and drilling. Aquarium and vivarium directions include fresh and saltwater aquaria, cements, aeration, siphons, temperature and humidity control and feeding. Sections on dissection, the microscope and teaching movies, and a fairly comprehensive index complete the book, which contains also a number of drawings of apparatus, and is conveniently interleaved throughout with blank pages for note-taking. Formulae for reagents are given in most, but not all, instances, but treatment times are often not specified. The extremely terse style makes for somewhat choppy reading in places, and occasionally leads to too much condensation (as in the directions for pithing frogs, and in the omission of mention of the hazards in the use of formalin, osmic acid and Hyrax), but on the whole the author is remarkably successful in presenting a large amount of very practical information in useful form.

JOHN BUCK

BIRD PORTRAITS. *A Book of Sketches and Paintings with a Commentary by the Artist.*

By J. C. Harrison; introduction by Seton Gordon. Country Life, London; Charles Scribner's Sons, New York. $12.50. 119 pp.; ill. 1949.

This is no ordinary book on birds. Rather, it is a volume which gives the author an opportunity to display his extraordinary skill as a watercolor artist, and his somewhat lesser skill as a descriptive naturalist. The 16 colored illustrations make up a superb set which would be a welcome addition to any collection of bird portraits. They differ strikingly from similar works of the better known American bird artists in their softness of tones, their lack of detailed markings which are rarely seen at a distance anyway, and the fidelity of natural setting. The landscaping details give evidence that the artist's skill is not limited to bird subjects. In addition to the watercolors, innumerable pencil sketches of birds done in the field provide a clue as to how the author goes about his work. The accompanying text serves merely to explain the circumstances surrounding the execution of the sketches and watercolors, and the habitats in which the author has found his subject material.

C. P. SWANSON

THE FREE-SWIMMING PLANKTONIC COPEPODA. *Systematic Account. The John Murray Expedition 1933-34 Scientific Reports. Volume VIII, Number 1.*

By R. B. Seymour Sewell. British Museum (Natural History), London. 1s. 10d. (paper). Pp. 1-303; ill. 1947.

THE FREE-SWIMMING PLANKTONIC COPEPODA. *Geographical Distribution. The John Murray Expedition 1933-34 Scientific Reports. Volume VIII, Number 3.*

By R. B. Seymour Sewell. British Museum (Natural History), London. 35s. (paper). Pp. 317-592 + 2 charts; text ill. 1948.

In the work on geographical distribution, Sewell has done much toward filling a long-felt need in the study of the Copepoda by gathering together the rather voluminous and scattered literature on distribution which he correlates with discussions of his own. These discussions deal with the effects of ecological factors on distribution and the origins of various faunas by way of ocean currents.

This work is divided into three main sections: Historical, Introduction, and Geographical Distribution; the latter is subdivided into two parts, the epi-planktonic species, and the meso- and bathy-pelagic species. A good bibliography is included. It might, however, be a little difficult for the general reader because there is no index, no table of contents, and no summary. Furthermore, many unnumbered lists of species (some quite lengthy) are interspersed throughout the text. While there is much useful information contained, it is difficult to get at unless one is thoroughly familiar with the book.

The systematic account deals with the taxonomy and locality records of the free-swimming and planktonic copepods taken primarily on the "John Murray" Expedition (1933-34) in Indian waters. It is done in Sewell's careful style and is well illustrated. The figures appear to be carefully drawn and are well reproduced in large size, a great help to workers on copepods.

WILLIAM SUTCLIFFE

FORAMINIFERA. *Their Classification and Economic Use. Fourth Edition, Revised and Enlarged, With an Illustrated Key to the Genera.*

By Joseph A. Cushman. Harvard University Press, Cambridge; Geoffrey Cumberlege, Oxford University Press, London. $10.00. x + 605 pp.; ill. 1948.

This fourth and latest edition of a work which first appeared in 1928 includes the added descriptions and illustrations of genera described between the appearance of the third edition in 1940 (cf. *Q.R.B.*, 15: 482, 1940) and the early part of 1948. The classification is the same as in earlier editions, with new genera inserted in the appropriate families. The ten introductory chapters are nearly identical with those of earlier editions, and do not always contain the latest information on such topics as the life history of living Foraminifera, their paleoecology, wall structure, etc.,

although some of these recent studies are listed in the enlarged bibliography. The introductory chapters discuss briefly (1) the living animal; (2) the test or shell, including its composition, form, ornamentation, etc.; (3) the collection and preparation of material; (4) methods of study, including types of slides for mounting, methods of mounting, drawing, photographing and thin-sectioning specimens, and an outline for the scientific description of Foraminifera, such as was followed by Cushman and others; (5) economic use, showing how range charts may be constructed; (6) geographic distribution, a discussion of living faunas, cold water and warm water types, pelagic forms, etc.; (7) geological distribution, with a summary of the Foraminifera throughout the geologic column, with certain portions discussed in more detail than others (the early Mesozoic being virtually ignored); (8) trimorphism, giving a discussion of Hofker's work; (9) classification, with Cushman's interpretation of the "primitive" and "advanced" types of Foraminifera upon which his classification is based; (10) research problems, listing topics upon which work is particularly needed.

Chapter XI, a Systematic Arrangement of Foraminifera, comprises the major portion of the volume, with the classification and descriptions of families, subfamilies, and genera. The section on Fusuline Foraminifera was prepared by Carl O. Dunbar and those on the families Orbitoididae, Discocyclinidae, and Miogypsinidae by T. W. Vaughan and W. Storrs Cole, and revised for this edition by Cole. This systematic chapter will be particularly helpful for taxonomists, inasmuch as nearly all genera described up to the date of publication are listed. The genera are described and illustrated with citations of genotype, original and occasionally additional references, synonomy, and geologic range. Chapter XII consists of a comprehensive bibliography, given according to topic. An illustrated key to the genera of Foraminifera consists of 55 plates, illustrating all the genera described in the earlier portion of the book. The first 40 or so of the plates are identical with those of the 2nd and 3rd editions, the newer forms being added at the end of this section.

Although there are some gaps in this work, such as the lack of recent information on the life cycle, this is nevertheless the most complete and the best illustrated of any publication to date on the Foraminifera.

ALFRED R. LOEBLICH, JR.

LARGER IMPERFORATE FORAMINIFERA OF SOUTH-WESTERN ASIA. *Families Lituolidae, Orbitolinidae and Meandropsinidae.*

By Francis Roger Spencer Henson. British Museum (Natural History), London. 1s. 10d. xii + 128 pp. + 16 plates; text ill. 1948.

This monograph deals with members of the following foraminiferan families: (1) Lituolidae, subfamily Lituolinae, in which a new genus, *Hauraniа*, is described; (2) Orbitolinidae, in which the new genera are *Lituonelloides*, *Coskinolinopsis*, and *Dictyoconella*; and (3) a new family, the Meandropsinidae, in which the new genera are *Broeckinella*, *Quataria*, *Edomia*, *Orbitolinella*, *Mangashtia*, *Pseudedomia*, *Zekritia*, *Dohaia*, and *Sandia*. The three families are considered to be polyphyletic by Henson. Keys have been prepared for each of the families, and should be very useful. The text is well illustrated, the drawings showing the form and internal structure of each of the various genera. A glossary of special terms is included. The paper is adequately illustrated by 16 plates, composed largely of microphotographs. It is regrettable that the quality of the plates is not equal to that of the text illustrations. Nevertheless, students of the Foraminifera will find this a stimulating study of a difficult group from a little known area.

ALFRED R. LOEBLICH, JR.

FORAMINIFERA OF THE CONTINENTAL SHELF FROM THE GULF OF MAINE TO MARYLAND. *Bull. Mus. Comp. Zool., Harvard College, Volume 100, Number 2.*

By Frances L. Parker. Museum of Comparative Zoology at Harvard College, Cambridge. $1.75 (paper). Pp. 211–254 + 7 plates + 1 chart; text ill. 1948.

This paper is based on material obtained from six traverses on the continental shelf from the Gulf of Maine south to Maryland. Over 300 species of Foraminifera were identified in the samples studied, but only about 150 diagnostic species were found to be useful in the immediate problem.

Two faunal provinces were recognized in the area: one extending from Maryland north to Cape Cod, and the second to the east and north of Cape Cod. In the traverses from Maryland to Cape Cod, four faunal zones were recognized, as follows: Zone 1, from 0 to 15 m., the littoral and sublittoral zones (the traverses studied did not include this zone); Zone 2, from 15 to 90 m.; Zone 3, from 90 to 300 m., in which was found the richest benthonic assemblage—the Lagenidae are almost entirely confined to this zone and are represented by at least 100 species; Zone 4, from 300 to 680 m., the outer limit being difficult to place, because of lack of data—the fauna of this zone does not have as great a variety of species as was found in Zone 3.

The region to the east and north of Cape Cod contains an assemblage quite different in character from that occurring between Cape Cod and Maryland. The assemblage is not as rich in species, and many of the species which occur rarely in the south, here form a high percentage of the fauna. Parker states that the

greatest difference between the two faunal provinces is the absence in the north of a large number of those species found in the south. It was found impossible to divide this area into definite faunal zones, probably because of the complete mixing of the water in winter, lower temperatures throughout the year, and the great annual variation in temperature.

An analysis of the physical conditions of the two regions suggests the probability that temperature is the chief controlling factor in the distribution of the Foraminifera. No reason was found for their varying abundance, although they are more numerous with increasing depth. Planktonic Foraminifera are confined almost entirely to the region south of Cape Cod, and are most abundant at about 400 m.

There are 6 tables showing the percentage distribution of benthonic Foraminifera and 4 showing the percentage distribution of the planktonic forms. 4 plates illustrate the species characteristic of Zones 2 to 4, inclusive, and there are 2 plates of species not confined to a single zone and 1 plate showing the planktonic Foraminifera.

ALFRED R. LOEBLICH, JR.

BIOLOGICAL ORGANIZATION AND STATION LIST. *B.A.N.Z. Antarctic Research Expedition 1929-1931 under the command of Sir Douglas Mawson. Reports—Series B (Zoology and Botany). Vol. I, Part 1.*

By T. Harvey Johnston. 5s. 6d. (paper). Pp. 1–48; ill. 1937.

FISHES. *B.A.N.Z. Antarctic Research Expedition 1929–1931 under the command of Sir Douglas Mawson. Reports—Series B (Zoology and Botany). Vol. I, Part 2.*

By J. R. Norman. 5s. (paper). Pp. 49–88; ill. 1937.

BIRDS. *B.A.N.Z. Antarctic Research Expedition 1929–1931 under the command of Sir Douglas Mawson. Reports—Series B, volume II.*

By R. A. Falla; edited by T. Harvey Johnston.

The B.A.N.Z.A.R. Expedition Committee; issued through the Barr Smith Library, University of Adelaide, Adelaide, Australia. 50s. (paper). xiv + 288 pp. + 4 plates; text ill. August 20, 1937.

Contributions from the British, Australian, and New Zealand Antarctic Research Expedition (1929–1931), under command of Sir Douglas Mawson, have been appearing since 1937. They comprise to date 12 quarto volumes. The report on the birds, by Robert A. Falla, a member of the expedition staff and now director of the Dominion Museum, Wellington, was issued 13 years ago, but it still deserves to be called to the special attention of naturalists outside the ranks of ornithologists.

Field work in the *Discovery* included three parallel voyages between latitude 40° S. and the Antarctic mainland. The limits were nearly half a circumference, or from Cape Town to a meridian beyond New Zealand. Macquarie Island and the little-known groups of Crozet, Kerguelen, and Heard were visited, and the east-west courses were linked by transects in both the Australian and Indian Ocean areas.

Falla has combined with his own observations the findings of Mawson's Australasian Antarctic Expedition (1911–1914). Viscissitudes due to war and other causes had led to the loss of specimens and the scattering of data, but the skillful salvaging and incorporation of much that was gleaned during the earlier venture add greatly to the value of the present work. Reproduction of 213 photographs offers a pictorial record without a peer in its field. There are also four color-plates illustrating plumages, and several useful charts and tables.

The report opens with a regional discussion dealing successively with the Southern Ocean, its insular groups, the pack-ice, and the Antarctic mainland. This is followed by the systematic section, in which 68 forms of birds, four of which are described as new, are discussed in terms of relationship, distribution, behavior, and ecology. The treatment is objective, well-founded, cautious in the face of evidence regarded as inconclusive, and replete with ideas of broad biological significance.

Falla's long experience and keenness are reflected in his constant insight into matters of adaptation. Apropos of this, Julian Huxley has recently written:

"When I was beginning my biological career, the whole notion of adaptation was largely rejected by the *avant-garde* biologists.... To-day, thanks... partly to experiment and close observation in the field... the very idea of biological neutrality has been called in question, and all or almost all characters are regarded as either adaptations or else as the correlates or consequences of adaptation."

Falla points out that the predacious skua gulls differ from their relatives in that females are larger than males, as in the birds of prey. "In other words, the larger size of females is correlated with habits rather than with family relationships." He notes that the evolution of the strange type of incubation in the king and emperor penguins, which carry the single egg on top of their feet, is foreshadowed by the brooding posture of certain nest-building species. In this report, as well as in earlier papers, he has shown that there are both spring- and autumn-nesting species among subantarctic and New Zealand petrels and, to a lesser

extent, among terns and birds of other families. The resulting summer and winter cycles make possible a multiple use of the same territory, which is in many areas limited in regard to the abundance of bird life. He shows convincingly that the recent increase of certain petrels of the Far South is due to a new and artificial food supply resulting from whaling operations. The conclusion is cognate with that of Fisher regarding the phenomenal "explosion" of the Arctic fulmar in the North Atlantic. Falla adds, however, the interesting observation that most of the subantarctic scavengers around whaling factories are non-breeding birds. When actually rearing young, they hark back to the natural ancestral diet, and some of them, such as the snow petrel, may make journeys from the nest in excess of 50 miles to obtain nutriment for the offspring, an observation since confirmed by naturalists of the Byrd Antarctic Expeditions. Finally, Falla emphasizes a fact so simple that it seems to have gone previously unexpressed, namely, that mere southward movement crowds sea birds into more and more restricted oceanic space because of the "narrowing of longitude." This is statistically important.

Elsewhere in his concise life histories, he calls attention to other phenomena of interest to biologists in many fields. He discusses the extraordinary size-range in the snow petrel, which is still not clearly understood, and he takes particular pains to point out the discreteness of certain breeding populations of birds of the same species occupying either remote or closely adjacent territories. Such differences may not be of systematic, i.e., nomenclatural, rank but they are, as presented, of extreme interest to students of speciation. The situation is well exemplified among two penguins at the Crozet Islands and by two extremely closely related forms of petrels, both of which breed at Kerguelen. Probably no one has preceded Falla in indicating the probable existence of transient polymorphism among petrels. *Procellaria aequinoctialis*, for example, has long been known for puzzling plumage phases. Falla writes: "From a study of the statements made by observers at sea during the last hundred years one is led to suspect that the facial markings of this petrel may vary not only according to locality but also in time, and that present-day observers . . . may search in vain for some of the distinctive patterns described by earlier investigators."

The concept of zonation has been greatly advanced by new information presented in this monograph. Certain forms of petrels, penguins, cormorants, etc., formerly lost in a fog of uncertain systematic status, are here shown to represent species or super-species occupying exclusive, parallel, circumpolar, zonal ranges that extend all the way from South America and West Antarctic to New Zealand and the islands to the south.

ROBERT CUSHMAN MURPHY

COLLEMBOLA. LORICATA. BRACHIOPODA. COLEOPTERA. *B.A.N.Z. Antarctic Research Expedition 1929–1931 under the command of Sir Douglas Mawson. Reports—Series B. Vol. IV, Part 1.*

By H. Womersley, B. C. Cotton, and H. Womersley. 5s. (paper). Pp. 1–36 + 1 plate; text ill. 1937.

CUMACEA AND NEBALIACEA. *B.A.N.Z. Antartic Research Expedition 1929–1931 under the command of Sir Douglas Mawson. Reports—Series B. Vol. IV, Part 2.*

By H. M. Hale. 3s. (paper). Pp. 37–56; ill. 1937.

DIPTERA. MISCELLANEOUS INSECTA. LEPIDOPTERA. *B.A.N.Z. Antarctic Research Expedition 1929–1931 under the command of Sir Douglas Mawson. Reports—Series B. Vol. IV, Part 3.*

By H. Womersley and N. B. Tindale. 4s. 6d. (paper). Pp. 57–86; ill. + 1 plate. 1937.

POLYCHAETA. *B.A.N.Z. Antarctic Research Expedition 1929–1931 under the command of Sir Douglas Mawson. Reports—Series B (Zoology and Botany). Vol. IV, Part 4.*

By C. C. A. Monro. 9s. 6d. (paper). Pp. 87–156; ill. 1939.

OPILIONES AND ARANEAE. *B.A.N.Z. Antarctic Research Expedition 1929–1931 under the command of Douglas Mawson. Reports—Series B (Zoology and Botany). Vol. IV, Part 5.*

By V. V. Hickman. 4s. 6d. (paper). Pp. 157–188; ill. 1939.

CRINOIDEA. *B.A.N.Z. Antarctic Research Expedition 1929–1931 under the command of Douglas Mawson. Reports—Series B (Zoology and Botany). Vol. IV, Part 6.*

By D. Dilwyn John. 3s. 6d. (paper). Pp. 189–212; ill. 1939.

ENDOPROCTA. *B.A.N.Z. Antarctic Research Expedition 1929–1931 under the command of Douglas Mawson. Reports—Series B (Zoology and Botany). Vol. IV, Part 7.*

By T. Harvey Johnston and L. Madeline Angel. 3s. 6d. (paper). Pp. 213–232; ill. 1940.

NEMERTEANS OF KERGUELEN AND THE SOUTHERN OCEAN. *B.A.N.Z. Antarctic Research Expedition 1929–1931 under the command of Douglas Mawson. Reports—Series B (Zoology and Botany). Vol. IV, Part 8.*

By J. F. G. Wheeler. 3s. 6d. (paper). Pp. 233–256; ill. 1940.

DECAPOD CRUSTACEA. *B.A.N.Z. Antarctic Research Expedition 1929–1931 under the command of Douglas Mawson. Reports—Series B (Zoology and Botany). Vol. IV, Part 9.*

By Herbert M. Hale. 5s. (paper). Pp. 257–286; ill. + 1 plate. 1941.

PYCNOGONIDA. *B.A.N.Z. Antarctic Research Expedition 1929–1931 under the command of Douglas Mawson. Reports—Series B (Zoology and Botany): Vol. V, Part 1.*

By Isabella Gordon. 10s. (paper). Pp. 1–72; ill. 1944.

PARASITIC NEMATODES. *B.A.N.Z. Antarctic Research Expedition 1929–1931 under the command of Douglas Mawson. Reports—Series B (Zoology and Botany). Vol. V, Part 2.*

By T. Harvey Johnston and Patricia M. Mawson. 12s. 6d. (paper). Pp. 73–160; ill. 1945.

ISOPODA-VALVIFERA. *B.A.N.Z. Antarctic Research Expedition 1929–1931 under the command of Sir Douglas Mawson. Reports—Series B (Zoology and Botany). Vol. V, Part 3.*

By Herbert M. Hale. 10s. 6d. (paper). Pp. 161–212; ill. 1946.

SIPUNCULIDS. THE MOLLUSCA OF MACQUARIE ISLAND (*Gastropods and Bivalves*). *B.A.N.Z. Antarctic Research Expedition 1929–1931 under the command of Douglas Mawson. Reports—Series B (Zoology and Botany). Vol. V, Parts 4 and 5.*

By A. C. Stephen (Part 4) and J. R. Le B. Tomlin (Part 5). 6s. (paper). Pp. 213–232 + 2 plates. 1948.

PLANKTON OF THE AUSTRALIAN-ANTARCTIC QUADRANT. *Part I. Net-Plankton Volume Determination. B.A.N.Z. Antarctic Research Expedition 1929–1931 under the command of Sir Douglas Mawson. Reports—Series B (Zoology and Botany). Vol. VI, Part 1.*

By Keith Sheard. 4s. 6d. (paper). Pp. 1–20. 1947. *Published by the B.A.N.Z.A.R. Expedition Committee and issued through the Barr Smith Library, University of Adelaide, Adelaide, Australia.*

The Collembola are represented by 13 species, all known, many taken in large numbers. A key to the genus *Cryptopygus* is included. 13 species of chitons were taken, 2 of them new. Of nearly a thousand brachiopods collected, 68% consisted of *Magellania macquariensis*; the others belong to 5 species, all known. A large amount of coleopterous material was obtained, all belonging to known antarctic forms, except for 1 new species and 1 new variety. There were numerous larvae in the material, especially curculionids.

The Cumacea obtained by dredging comprise 10 species (4 new); there was 1 known nebaliacean.

The collection of Diptera was large, comprising 19 species, many represented by hundreds of specimens, of which 4 species are described as new. Of other insects, there were taken 1 orthopteran, 1 dermapteran, 2 hemipterans, 1 neuropteran, 1 psocpteran, 1 hymenopteran, and 2 siphonapterans. Only a few Lepidoptera were taken, including 1 new species.

The polychaetes of the expedition comprise 143 species (8 new), belonging to 103 genera and 28 families.

The large collection of 444 specimens of phalangids and spiders contained few species. *Myro kerguelenensis* constituted 80% of the spiders, which included 3 other known and 4 new species. There were 42 specimens of a single phalangid, *Nuncia unifalculata.*

The 596 specimens of crinoids consisted of 9 species plus some pentacrinoid larvae; 2 of the species are new, one being representative of a new genus.

Entoprocta is the correct spelling of the name of the next group. Most of the material belonged to the genus *Barentsia*, of which there are described 1 known, and 3 new species plus 1 new variety.

As in other groups, the large collection of over 650 nemertean specimens consisted of but few species, more than half belonging to the one species *Lineus corrugatus*; other common species in the collection were *Amphiporus moseleyi, Tetrastemma unilineatum,* and *T. validum.* There are described 11 other known species and 4 new species, one the type of a new genus *Nemertopsella.*

39 species of decapod crustaceans, belonging to 20 families, are described (3 new species and 2 new subspecies).

The nematodes came from mammals, mostly whales and seals, sea birds, and fish collected on the expedition. Material from the previous Australasian Antarctic Expedition is included. Nematodes were found common in fish but seldom in the birds and mammals studied. Most of the nematodes found were ascaroids and spiruroids. It is pointed out that the name *Anisakis* is invalid and is to be replaced by *Stomachus* Goeze.

In addition to the 13 species (4 new) of Isopoda-Valvifera taken by the expedition, there are included 10 species (5 new) and 1 new subspecies from Australia and New Zealand.

The 349 specimens of sipunculids taken were referred to 7 known and 1 new species, nearly all of the genus *Phascolosoma.*

There are now known 49 species of gasteropods and bivalves from Macquarie Island, of which 18 are not known to occur elsewhere. This includes 3 new snail species described in the present article.

A comparison of the relative merits of the displacement and settlement methods of assessing plankton volume leads to the conclusion that the settlement volume is unreliable and the displacement volume is a more useful method of measuring plankton mass. The volumes of plankton taken in 70 net hauls by the expedition are tabulated as displacement volumes. It appears that in summer the bulk of the net plankton is found in the upper 100 meters. The volume of plankton in Antarctic waters is similar to that from Cape Cod, Chesapeake Bay, Gulf of Maine, Nova Scotia, and Iceland.

L. H. HYMAN

THE FAUNA OF KRAKATAU 1883–1933. *Verhandelingen der Koninklijke Nederlandsche Akademie van Wetenschappen, Afd. Natuurkunde. Tweede Sectie, Deel XLIV.*

By K. W. Dammerman. N. V. Noord-Hollandsche, Amsterdam. f. 25.00 (paper). xii + 594 pp. + 11 plates; text ill. 1948.

The eruption of Mt. Krakatau in the Straits of Sunda provided ecologists with an excellent opportunity to study the return of life to an island area rendered essentially sterile by the fall of hot ash. This work represents the most extensive study on the zoological effects of this explosion.

The book is divided into two parts, the first or general part consisting of ten chapters and a summary. These deal with discussions of the fauna of the island group around Krakatau before eruption, the fauna of adjacent islands from which fresh stocks could come, and of the succession of recolonization. The second part of the book deals with the detailed taxonomy of all the animals involved in the study, these being a considerable company.

This book should be of extreme interest to ecologists, even though, as the author notes, various difficulties have stood in the way of making all the observations that would have been desirable. The existence of these difficulties, however, add to rather than detract from so careful and exhaustive a study, for they reveal the problems that must be solved in order to approach perfection in work of this sort.

JOHN CUSHING

KEEP THEM ALIVE. *How to Keep Snakes, Lizards, Turtles, Alligators, and Crocodiles in Captivity. Special Publication No. 1.*

By E. Ross Allen and Wilfred T. Neill. Ross Allen's Reptile Institute, Silver Springs, Florida. 75 cents (paper). 24 pp.; ill. April, 1950.

Here is a short and useful booklet on how to maintain reptiles alive in captivity. An annotated bibliography accompanies the text.

POISONOUS FISHES OF THE SOUTH SEAS. *Special Scientific Report: Fisheries No. 25.*

Translated from the Japanese language by W. G. Van Campen. U. S. Dept. Interior, Fish and Wildlife Service, Washington, D. C. Paper. ii + 221 pp. 1950.

CIGUATERA: TROPICAL FISH POISONING. *Special Scientific Report—Fisheries No. 27.*

By William Arciss. U. S. Dept. Interior, Fish and Wildlife Service, Washington, D. C. Paper. 23 pp. May 1950.

The first of these mimeographed publications includes translations of several Japanese papers, one of which offers the suggestion that the poison of tropical fishes is in some way related to the nematocysts of corals, and another which suggests some relation to the gonads. However, the work includes a considerable fund of information about the toxicity and distribution of various fish (it is unfortunate that the illustrations and maps could not also be reproduced), with detailed data on experiments with fish poison on experimental animals. There are also a few historical and literary gems: "Our research team, overcoming unforeseen difficulties and inconveniences, visited various South Sea Islands insofar as available transportation facilities permitted, and . . . all returned safely on December 4 with the precious material which they had assembled. Only four days later the war broke out and the declaration of war was promulgated, which can only be regarded as a miracle of divine providence."

The paper by Arciss is concerned with poisoning associated principally with barracuda and *Caranx* in the West Indies, and like the more pretentious Japanese study, still leaves the essential nature of the poison undetermined.

JOEL W. HEDGPETH

DISPERSAL, AMOUNT OF INBREEDING, AND LONGEVITY IN A LOCAL POPULATION OF PRAIRIE DEERMICE ON THE GEORGE RESERVE, SOUTHERN MICHIGAN. *Contrib. Lab. Vert. Biol. Univ. Mich., No. 43.*

By Walter E. Howard. University of Michigan Press, Ann Arbor. 50 cents (paper). 50 pp. + 2 plates; text ill. 1949.

The author usually spent the equivalent of a full day a week for nearly 2 years (November 1, 1940, to October 12, 1942) on field work with a population of *Peromyscus maniculatus bairdii* on about 300 acres of grassland. More than 1200 of these mice were marked and handled a total of more than 4000 times. The work was facilitated by the use of 136 artificial nest boxes of types readily accepted by the mice as homesites; locations for the next boxes were chosen on the basis of the likelihood of the mice adopting them, and most were separated by distances of 150 to 300 feet. Information was obtained particularly on such topics as sociality, breeding, home ranges, dispersal, food storage, and mortality under the conditions then existing on the George Reserve. The data suggest a substantial amount of inbreeding, rather more mobility than that brought out by earlier studies of the subspecies in Michigan, and what appears to be astonishingly high mortality and unimpressive reproductive success. The investigation itself seems competent, so far as it goes, but again illustrates the common experience of graduate students that two years hardly afford more than a good start on complex ecological field problems. A reader may well ask, with the author, how much the extremes in mortality (and perhaps in some other things) may be due to the situation of the research area near the northern limits of the geographic range of the prairie deermouse—or to plant

succession following reversion from farm crops or to impacts of the large herd of white-tailed deer known to be enclosed in the Preserve.

PAUL L. ERRINGTON

GUIDE TO ZOOLOGICAL EXPERIENCES.

By Jessie L. Metcalf and Charles W. Creaser. Published by the Authors, Wayne University, Detroit; lithoprinted by Edwards Bros., Ann Arbor. $3.60. xxii + 421 pp. 1949.

The *Guide* is the outcome of a number of years of teaching an elementary zoology course at Wayne University, Detroit, for both pre-professional and general students. The course consists of approximately 6 hours of laboratory, 2 hours of discussion, and 2 hours of library work per week. The policy of having small biology classes, each taught by a regular faculty member (plus a teaching assistant), is maintained at the University, and the *Guide* is designed for this type of class, serving as an aid in integrating laboratory, discussion, and library work.

"The aim . . . is to present a plan of instruction . . . which will discover and develop students who are capable of making a scientific approach to an understanding of their environment" (p. iv). The objectives expressed in the preface may be paraphrased as follows:

(1) to provide opportunity for insight into biology as a method of inquiry by keeping the course in close contact with primary scientific sources, i.e., the laboratory and the literature;

(2) to integrate the subject matter of the course by returning constantly to a specific organism (an amphibian) in order to maintain the thread of continuity after excursions into the various branches of modern biology;

(3) to present both the method of inquiry and the integrating organism within the larger perspective provided by the student's previous contacts with the biological aspects of his community.

The laboratory occupies a central position in such a plan of instruction. Laboratory directions are organically interwoven into the *Guide*, and it would be difficult to decide where "laboratory manual" ends and "textbook" begins, if one wished to make such a distinction. The textual portions consist of summarizations, interpretations, and extensions of laboratory observations, but in addition they intentionally cover certain aspects of each subject in outline form only, to be completed by following up the literature references included with each section. Besides a laboratory, a well-stocked reserve library is indispensable for the successful use of this *Guide*. It is apparent that an integral part of the teaching method practiced by the authors is the abandonment of the lecture method. The laboratory and the library, they feel, provide more adequate source material than do lectures, while the integrating function of the lecture is taken over by the discussion.

It is always difficult to incorporate a representative selection of biological material within the one or two semesters allotted to an elementary zoology course. Some instructors try "going through the phyla" from the bottom to the top, or from the top to the bottom. Others have abandoned taxonomic series and have reduced biology to physics and chemistry or have placed emphasis on human physiology. The unifying device used by Metcalf and Creaser is the "representative vertebrate" (an amphibian). If well handled, such an approach can give a picture of the functioning organism which an encyclopedic survey of the phyla lacks, and which is more likely to represent the biological viewpoint than would either physicochemical reductionism or anthropocentric physiology. Aside from the introductory chapters and the last few chapters on genetics and evolution, most of the *Guide* is built around the various aspects of amphibian anatomy and physiology. Discoveries made with the amphibian are extended to other living things wherever it is valid to do so. Cell structure and physiology, for example, first met with in the context of the chapter entitled Anatomical and Histological Analysis of a Region, is broadened in several succeeding chapters to include the physiological and chemical properties of protoplasm in general. In this way the student is led from the grosser and more easily grasped features of the organism, which are usually specific for the animal studied, to the finer and subtler aspects, which are generally characteristic of all living things. The natural history and classification of the frog are expanded into chapters on general taxonomy and ecology.

The pitfalls of such an amphibian-oriented procedure are rendered less dangerous by pointing out to the student its limitations, and by a series of introductory chapters which give perspective. Before entering the narrow pass, so to speak, a good deal of time is spent in reconnoitering. In fact, these first chapters are the most distinctive feature of the *Guide*. Precautions are taken to make the student self-conscious about his own role as observer and about the experiences and predilections he brings with him to the course. The authors feel that the broadest kind of perspective is obtained when the student as learner is himself made an object of scientific inquiry. The student, the teacher, the course, the science of biology, and the community are introduced as direct or indirect participants in the learning process. There is hardly an aspect of the total situation that is taken for granted, and it may be well to insure that a science course should take for granted as little as possible.

The reviewer is in agreement with the aims and the general plan of attack in the *Guide*. Criticisms would take the form of suggestions for alteration of specific sections, particularly Chapters 28–30 on germ cell maturation, genetics, and evolution. Since the ap-

proach of most of the book is one in which the student is presented with the laboratory data first and then guided to inductions from the data, one might suggest that it would be more consistent with the rest of the book to present the student with the breeding data from which the Mendelian generalizations are drawn *independently* of the cytological parallels and *later* to demonstrate the correlation between Mendelian breeding factors and chromosomal behavior. The conclusion that the chromosomes are the material bearers of the hereditary factors could come after rather than before the Mendelian generalizations. In addition to the order of presentation, the subjects of genetics and evolution might perhaps be expanded and given some further mathematical treatment, such as using the binomial expansion with multiple factors to demonstrate how characters showing continuous variation are accounted for on a Mendelian basis. However, reference to the literature is made on the subject, and the interested student is given the opportunity to explore this for himself. Most chapters and the whole of the last chapter contain supplementary exercises.

With regard to style, the *Guide* is excellently written and clearly understandable. There is in a number of places a tendency to over-generalize, but this may be an error which no elementary book can avoid and still be coherent. The organization of the course around the laboratory and the library would undoubtedly serve as a corrective in this respect.

ROY GILLETTE

ON SOME SPECIES OF LERNAEA (*Crustacea, Copepoda: Parasites of Fresh-Water Fish*). *Bulletin Brit. Mus. nat. Hist., Zool., Vol. 1, No. 1.*

By J. P. Harding. 7s. 6d. (paper). Pp. 1–28; ill. 1950.

ON A GIANT SQUID OMMASTREPHES CAROLI FURTADO STRANDED AT LOOE, CORNWALL. *Bull. Brit. Mus. nat. Hist., Zool., Vol. 1, No. 2.*

By W. J. Rees. 4s. (paper). Pp. 29–42 + 2 plates; text ill. 1950.

THE IDENTITY OF CAPTAIN COOK'S KANGAROO. *Bull. Brit. Mus. nat. Hist., Zool., Vol. 1, No. 3.*

By T. C. S. Morrison-Scott and F. C. Sawyer. 3s. (paper). Pp. 43–50 + plates 3–5. 1950.

The new *Bulletin of the British Museum* (*Natural History*) is to be issued in 5 series corresponding to the Departments of the Museum. They will appear at irregular intervals, volumes (300–400 pages) not necessarily being completed within one calendar year.

The series in *Zoology* begins with a revision of the genus *Lernaea*. The author recognizes 28 species, 9 of which are new. Seven existing species are relegated to the synonymy. A key to the 28 species, and figures for the 14 in the British Museum collections are provided.

The second paper describes the details of a female giant squid (186 cm. in overall length) that was stranded alive on the Cornish coast. Other records of giant squids stranded on Great Britain are tabulated and the locations mapped. This species, well illustrated in the plates, is known only from strandings and so far all specimens have been females. The current specimen is the second largest known.

The third paper is a belated attempt to identify Captain Cook's kangaroo from illustrations, since the sole remaining skeletal material, a skull, was destroyed by bombing in World War II. A wash drawing of a skull (by N. Dance) is identified as belonging to a wallaroo, *Macropus robustus*. A photograph of the skull that was bombed reveals it to be that of a young Great Grey Kangaroo (*M. canguru*).

THE SALTICID SPIDERS OF JAMAICA. *Bull. Mus. Comp. Zool. Harv. Coll. Vol. 103, No. 3.*

By Elizabeth B. Bryant. $1.25 (paper). Pp. 163–209 + 3 plates. 1950.

In this paper 26 species are described, 9 of which are new; of 16 genera, 6 are new. Twenty species are restricted to Jamaica, including the 9 new species, all of which have been collected only on the main range of the Blue Mountains, above 3000 ft. A fine example of island endemism.

A CATALOGUE OF THE HESPERIIDAE FROM EUROPE, ASIA AND AUSTRALIA IN THE BRITISH MUSEUM (NATURAL HISTORY).

By Brigadier W. H. Evans. The British Museum (Natural History), London. £4. 0s. 0d. xix + 502 pp. + 53 plates. 1949.

This valuable addition to the literature of the Hesperioidea is a companion volume to the *Catalogue of the African Hesperiidae* (1937). Evans has rendered inestimable service to lepidopterists by bringing together in such compact form surveys of large and difficult faunas. Including his monograph on *The Identification of Indian Butterflies* (1927), his published works now provide for the identification of the skippers of all parts of the world save North and South America.

The term "catalogue" may be misleading to those who are not familiar with publications of the British Museum under this title. They are intermediate between monographic surveys and catalogues in the usual sense, since they include not only a list of taxonomic groups and species with essential bibliographic notes and data on distribution, but also means of identification.

The organization of the volume under consideration differs conspicuously from that of the *African Hesperiidae*. The author has reverted to a unique system

of keying which was used in the *Indian Butterflies*, after adopting a more generally familiar plan in the intervening volume. At first acquaintance his procedure seems complex and difficult. One must certainly agree with Riley's prefatory comment that is it unusual and that the whole work is unorthodox in comparison with other British Museum catalogues. The apparent difficulty disappears, however, very quickly. It is simply the result of unfamiliarity, and once one has mastered the procedure, use of the book is as easy as that of any other taxonomic treatise.

The introduction includes an ample explanation of the system of abbreviations used for economy of space and of the morphological terms employed. Six pages are occupied with a key to groups, 38 pages with a key to genera, and the remainder of the text is organized as a progressive key to species in which descriptive matter is used only as the basis of the key. Genera are cited with the original reference, the type and the manner of its fixation, and synonyms with the same information. The ultimate treatment of species and subspecific divisions includes only skeleton bibliographic references, type localities and present location of types, synonyms with similar details, and distribution based on the British Museum collections. By this method the author has included an immense amount of basic information in little space.

Appendix A contains a bibliography of specific titles, less definite mention of the publications of some authors, brief notes on collecting activities, and data on the acquisition of collections by the Museum. The brief Appendix B lists species erroneously referred to the region included here, with proper identification and distribution of all but a few species. The index is a list of generic and specific names, both valid and synonymic. It utilizes the unique numbering system of the keys instead of page numbers, but proves very convenient.

In testing the practicability of the treatment with Australian and Asiatic specimens, the reviewer has been troubled by the occasional use of genitalic characters for keying and by distinctions which seem too finely drawn for dependable use. Such difficulties, however, are probably unavoidable in this group, since its structural uniformity has always been a stumbling block. In short, no survey of an extensive hesperioid fauna can reduce identification to a state of positive ease; and so the author cannot be blamed for failing to do so.

Some taxonomists will disagree with the rank to which various names are assigned. Under *Hesperia comma* L., for example, *benuncas* Obth., *shandura* Evans, *dimila* Moore, and *florinda* Butl. are listed as subspecies. The last 2 are genitalically very different from *comma* and the first differs strongly in superficial characters, hence they are certainly not conspecific. This treatment does not, however, interfere with the identification of the insects.

A more serious criticism is that the line drawings lack precision. The lack is unimportant in the introductory figures of structural details, but in the 42 plates of genitalia it can lead to uncertainty even after one has gone to the trouble of making dissections. In contrast, the first 11 plates are superbly executed. They illustrate in color 131 species and forms not previously figured.

No one who has had experience with the difficulties of skipper taxonomy can fail to appreciate the tremendous knowledge that Evans has brought to the preparation of this book and the great labor involved in the work. He deserves the gratitude of all lepidopterists for making so conveniently available the information once scattered widely in periodicals and rare books and, even more inaccessibly, in many museums.

A. W. LINDSEY

SOUTH CAROLINA BIRD LIFE. *Contributions from the Charleston Museum: XI.*

By Alexander Sprunt, Jr., and E. Burnham Chamberlain; edited by E. Milby Burton, Director. Original Paintings by Francis Lee Jaques, Roger Tory Peterson, Edward von S. Dingle, and John Henry Dick. University of South Carolina Press, Columbia. $10.00. xx + 585 pp.; ill. 1949.

This lavishly illustrated volume will take its place among the more impressive state bird books. The 35 colored plates are the work of F. L. Jaques, R. T. Peterson, and others, while the photographs include the works of such experts as A. R. Cruickshank and S. A. Grimes. Among the introductory chapters the most interesting is one which traces the history of ornithology in South Carolina from the pioneering work of Catesby to the present. The main part of the book is devoted to a detailed account of every species or race of bird ever recorded from South Carolina. Sprunt is a recognized expert at field identification, and the number of birds admitted to the list on this basis alone is higher than usual. The limitations of this method are occasionally evident, as in the controversy about the status of the Carolina Paroquet. It must be admitted, however, that these sight records are probably no more questionable than those of many of the subspecies recorded from specimens. An astonishing number of western or northern races have been admitted to the South Carolina list on the basis of 1 or 2 specimens identified by various taxonomists. The mistaken view that it is more "scientific" to pin a subspecific name upon every record or specimen has prevailed here, and we find, for example, the burrowing owl, of which there is no specimen and only 1 sight record for the state, listed under the subspecific name of the western population because the latter is migratory while the Florida race is not!

South Carolina Bird Life is a handsome and—so far as it goes—informative volume. Some will regret the

absence from its pages of any serious attempt to give the amateur bird student a little basic, up-to-date information on such topics as ecology, predation, population dynamics, and even perhaps on the significance of the numerous subspecies whose mere listing takes up no inconsiderable portion of the text.

DEAN AMADON

THE AWL-BIRDS.

By J. K. Stanford; illustrated by A. M. Hughes; introduction by Helen G. Cruickshank. The Devin-Adair Co., New York. $2.00. 90 pp.; ill. 1949.

After an absence of more than a century the avocet, or awl-bird, has returned to England as a breeding bird. With this exciting fact as a background, the author has woven a skilful bit of fiction whose charm and simplicity guarantee an hour of delightful reading. The refreshing pen-and-ink drawings by A. M. Hughes contribute greatly to the enchantment of the story. It is a pleasure to recommend this little volume.

V. G. DETHIER

ECONOMIC ZOOLOGY

STUDIES ON THE PACIFIC PILCHARD OR SARDINE (SARDINOPS CAERULEA). *Special Scientific Report: Fisheries No. 15. Reissue of Special Scientific Reports 19–24, issued in 1943.*

By Oscar E. Sette, Lionel A. Walford and Kenneth H. Mosher, Elbert H. Ahlstrom, and Ralph P. Silliman. U. S. Dept. Interior, Fish and Wildlife Service, Washington, D. C. Paper. iv + 200 pp.; ill. May 1950.

THE PEARL FISHERY OF VENEZUELA. *Special Scientific Report: Fisheries No. 26.*

By Paul S. Galtsoff. U. S. Dept. Interior, Fish and Wildlife Service, Washington, D. C. Paper. 26 pp.; ill. May 1950.

THE PEARL RESOURCES OF PANAMA. *Special Scientific Report: Fisheries No. 28.*

By Paul S. Galtsoff. U. S. Dept. Interior, Fish and Wildlife Service, Washington, D. C. Paper. 53 pp.; ill. May, 1950.

The first of these two reports is a summary of interviews with officials, dealers, and fishermen, based on a brief visit to the Venezuela pearling grounds. The report on the Panamanian pearl fishery is based on a more detailed study of the general marine ecology of the region and includes therefore an original contribution to the intertidal and subtidal ecology of a region not previously reported upon.

JOEL W. HEDGPETH

POLLUTION IN THE LOWER COLUMBIA BASIN IN 1948—*with particular reference to the Willamette River. Special Scientific Report: Fisheries No. 30.*

By Frederic F. Fish and Robert R. Rucker. U. S. Dept. Interior, Fish and Wildlife Service, Washington, D. C. Paper. 22 pp. June 1950.

COMMON INSECT PESTS OF STORED FOOD PRODUCTS. A *Guide to Their Identification. Second Edition. Brit. Mus. Nat. Hist. Econ. Series, No. 15.*

By H. E. Hinton and A. Steven Corbet. British Museum (Natural History), London. 1s. (paper). iv + 52 pp.; ill. 1949.

This edition is a marked improvement over the first which was issued in 1943 (cf. Q.R.B., 19: 54). Many new illustrations have been added and the keys are more fully explained, especially those of the moths. The authors have attempted "to make easy the identification of the insects and arachnids commonly associated with stored food products in this country." The task is a difficult one. By means of many illustrations, simple keys, and descriptions, the authors have given us a work that should be of great help to the entomologists as well as to laymen. The senior author is an authority in this field, a fact well illustrated by his book *A Monograph of the Beetles Associated with Stored Food Products*" (cf. Q.R.B., 21: 90). In the present work the various species are dealt with systematically, order by order. No attempt has been made to select the best or the current control measures in use in Great Britain. To have included the latter would have added much to the value of the work.

ROBERT MATHESON

GALL MIDGES OF ECONOMIC IMPORTANCE. *Volume VI: Gall Midges of Miscellaneous Crops.*

By H. F. Barnes, with a foreword by A. Roebuck. Crosby Lockwood & Son, London. 15s. 229 pp. + 14 plates. 1949.

This is one of the 8 volumes to be issued under the general title of *Gall Midges of Economic Importance.* The first 4 volumes have already been reviewed (Q. R. B., 23: 63; 24: 61; 25: 89); volumes V, VII, and VIII are in preparation and should be issued shortly. Like the preceding volumes the author gives us a preface explaining the general procedure and a brief statement of the sources available to him.

In 11 sections the present volume treats of the gall midges injurious to Bamboos, Basket Willows, Beverage plants, Dye plants, Fibre or Textile plants, Herbs (Aromatic, Culinary, and Medicinal), Insecticide plants, Oil plants, Rubber plants, Spice, and Sugar plants. At the beginning of each section the author gives a brief resumé of the importance of the plants under

consideration, with brief historical notes; then follows a list of the plants to be considered, with their known gall midges. The main part of each section is devoted to a description of the galls and their inhabitants, with brief notes on known control measures. Many of the galls are illustrated by photographs. By following this plan it is easy to find whatever specific information the reader is seeking. Furthermore, under each midge discussed the more pertinent publications on it are listed. The volume concludes with a bibliography of 362 titles, an index of generic, specific, and popular names of gall midges, a plant index, and a general index. The indexes are extensive and ought to meet the needs of anyone seeking information on the galls of the plants discussed.

The reviewer has found this volume of great interest, especially the introductory notes dealing with the plants under each section. To the entomologist and those interested in general biology this volume should prove of value not only from an economic standpoint but also because of valuable notes on the plants themselves.

ROBERT MATHESON

THE RATIONAL EXPLOITATION OF THE SEA FISHERIES *with Particular Reference to the Fish Stock of the North Sea. Special Scientific Report: Fisheries No. 13. Paper No. 36, Dept. of Fisheries, Ministry of Agriculture, Fishery and Food Supply, The Hague, Netherlands, July 1947.*

By G. P. Baerends; translated from the Dutch by Jan Hahn; edited by Howard A. Schuck. United States Department of the Interior, Fish and Wildlife Service, Washington, D. C. Paper. 102 pp.; ill. 1950.

POSSIBILITIES FOR OYSTER CULTURE IN PUERTO RICO AND THE VIRGIN ISLANDS. *Special Scientific Report: Fisheries No. 9.*

By Walter A. Chipman and Paul E. Thompson. United States Department of the Interior, Fish and Wildlife Service, Washington, D. C. Paper. 19 pp. 1950.

BIOLOGICAL INVESTIGATIONS OF THE FISHERY RESOURCES OF TRINITY RIVER, CALIFORNIA. *Special Scientific Report: Fisheries No. 12.*

By James W. Moffett and Stanford H. Smith. United States Department of the Interior, Fish and Wildlife Service, Washington, D. C. Paper. ii + 71 pp. 1950.

THE 1950 OPENING OF THE BONNET CARRE SPILLWAY: *Its Effect on Oysters. Special Scientific Report—Fisheries No. 14.*

By Philip A. Buller (Mississippi) and James B. Engle (Louisiana). United States Department of the Interior, Fish and Wildlife Service, Washington, D. C. Paper. 10 pp.; 2 charts. 1950.

This assortment of papers represents a fair cross section of the fisheries activities of the Fish and Wildlife Service. On the good side of the ledger we may place No. 13, a translation of an important Dutch paper, and No. 12, a report based on several seasons of field investigations. However, one wishes a more positive statement would be made by biologists about the ecological aspects of diverting water from one drainage to another, instead of the tacit acquiescence to engineering schemes we find here. Report No. 9 is a routine survey report of the sort that has been produced many times before. No. 14, however, is something quite different. Here is a report of some 10 pages, including sketch maps and open spaces, of work done between February 10 and March 11, 1950. The first table consists principally of 30 asterisks, indicating that the data "are not complete at this time." As a contribution to the vast literature on oysters this paper is valueless, and it is plain that the motive for rushing into print with this extremely preliminary report is not to convey information. Such precipitate haste as this reflects little credit on the responsible persons in an agency presumably devoted to an impartial analysis of fisheries problems for the benefit of the people as a whole rather than a concern about rescuing a fellow bureau from a potentially embarrassing predicament.

JOEL W. HEDGPETH

RAISING GAME BIRDS IN CAPTIVITY.

By David B. Greenberg. D. Van Nostrand Co., New York. $4.95. xiii + 224 pp.; ill. 1949.

Raising game birds is a riskier enterprise and subject to more hazards than poultry breeding. With the aid of this book, however, anyone interested in that particular field of endeavor will find that many difficulties can be circumvented. Considerable data are given on the proper methods of artificial incubation, brooding, hatching, rearing feeding, wing clipping, predator control, and other topics vital to the subject. The vagaries of each species, pheasant, quail, chukar, Hungarian partridge, and wild turkey, are described. This description often goes into complete detail on proper dieting, sexing, and age determination. Many illustrations depict methods of handling, views and layouts of successful game farms, and particularly construction details for various kinds of traps, feed hoppers, pens, and other appurtenances of the trade. The author is at his best with the aforementioned subjects. The title of the first chapter, The Importance of Wild Life in Nature, is certainly a misnomer. The second chapter, The Business of Farm Game Bird Production, should be made more convincing and be expanded since anyone entering this field has a right to expect an exposition on its value and the opportunities that are available. The third chapter, Game Bird Classification, portends the worst from its opening sentence,

"Since there is considerable confusion in the nomenclature of upland game birds, we turn to the 1939 Year Book of the United States Department of Agriculture for our definitions." All 5 subspecies ("varieties") of the wild turkey are listed and their ranges are outlined, but no such treatment is accorded the bobwhite and the grouse. Aquatic game birds are mentioned in a final paragraph but no attempt is made at their classification, leaving the unsuspecting reader with the impression that they belong with the *upland* game birds. This chapter should be omitted or rewritten with some purpose in mind. Happily, beyond the third chapter everything turns out well, so that the book can be recommended to all who think about, or are interested in or actively engaged in game bird production.

HENRI C. SEIBERT

LES CONQUÉRANTS AILÉS. *Le Doryphore; La Sauterelle Migratrice. (Les Bois, Les Champs et Les Jardins-Vues sur le Monde Animal, VIII.)*

By Marcel Roland. Mercure de France, Paris. 90 fr. 284 pp. 1947.

This, the eighth in a series by the same author, deals with the Colorado potato beetle, which Roland prefers to call by the wrong name (Doryphore, rather than *Leptinotarsa*) because it is more euphonious, and also with two migratory grasshoppers of Africa. In each instance the insect he has selected "pour 'personnage'" is identified, then described in a combination of chatty detail that seems to fit no particular audience. It is too technical in spots for any but an entomologist, and in others too conversational except for children. The story of the spread eastward of the beetle, including observations on its behavior in Europe, is well done. The grasshoppers are less easy to keep distinct since two types are described in parallel—one from the Nile estuary, the other from the basin of the Niger. In life they are as separate as the Sahara desert can keep them; in print they merge and lose identity, without an element of contrast to justify the treatment.

LORUS J. & MARGERY J. MILNE

BOBWHITES ON THE RISE.

By Verne E. Davison; with illustrations by Wallace Hughes. Charles Scribner's Sons, New York. $3.75. 150 pp.; ill. 1949.

The bobwhite quail has always been a favorite bird for gun and table, but unfortunately its numbers are decreasing and it is becoming less and less available as a target for the sportsman. Numerous attempts have been made to restore it to its former abundance, and while in certain areas success has been attained, over the major proportion of its extensive range it has not shown any improvement. The author reviews the difficulties and errors in previous attempts and recommends methods of management which are necessary to increase its numbers. It is pointed out that refuges are of no benefit; the idea that "if you don't interfere, nature will take care of itself" does not restore quail. Predator control is a waste of time and money since predators have little, if any, influence on quail populations. Restocking is not helpful. Nor has education (of the public) benefited the quail, since no one has known exactly what to teach.

The thesis of this book is to emphasize the fact that the conservation and restoration of quail is not a sportsman's problem but actually an agricultural problem to be handled by the farmer and to which the hunter must find some way to contribute. This means that the relationship of farmer to hunter must be altered in such a way that the sportsman realizes that just because he holds a license he has not the right to hunt wherever he pleases. Furthermore, if the landowner is made to feel that he owns the birds on his land and that their hunting is only by his permission, then he will have an incentive to provide the time, labor, and expense to habilitate his land for wildlife. Hunting then becomes a privilege, not a right.

A description of methods to improve the land for bobwhite naturally constitutes the major portion of this book. Food is regarded as the most important factor, especially food during the winter season in sufficient quantity to feed the covey easily. Bicolor lespedeza is the recommended plant food; other plants are listed and evaluated. Cover is also essential, and two kinds are necessary, grassy and shrubby. In discussing the aspects of these requirements, Davison believes that the quails' needs have been heretofore considered as much more complex than they really are. Thus among the types of cover, the following were considered necessary: roosting, resting, loafing, nesting, emergency, escape. Actually, only two types are required. Similarly for food—these birds do not need as great a variety as has been supposed, since one kind will suffice provided it is available all the time in sufficient quantities. Where and how to provide these quail essentials on various types of land, such as pasture, cropland, and idle land, are described. The number of quail to be expected on managed land, some facts concerning the life history and vital statistics of quail, and methods to organize landowners and hunters for their mutual benefit are discussed. The presentation of these basic facts ought to provide incentive to anyone interested in maintaining, restoring, or increasing these birds. This is a good book and the author's viewpoints are forcibly expressed—we only hope that he is right.

HENRI C. SEIBERT

SPIDERS OF CONNECTICUT. *State of Connecticut Public Document Number 47. State Geological and Natural History Survey Bulletin Number 70.*

By Benjamin Julian Kaston. State Geological and Natural History Survey, Hartford. Paper. 874 pp.; ill. 1948.

For the general biologist, whether his aranean interests are those of the laboratory specialist, the field naturalist, or the amateur, this scholarly work is invaluable. It not only describes and classifies every spider species found in the Connecticut region (including adjacent areas in New York, Rhode Island, and Massachusetts), 597 in all, but, and this is what makes the book highly attractive to the non-specialist with a curiosity about the nature of things, habits are briefly summarized, anatomical features significant for identification are illustrated, and the bibliographical references are complete.

If, for example, the reader has an urge for knowledge about the large black and yellow spider spinning her orb-web with the zig-zag signature among the flowers in his garden, he may, without too great difficulty, using the keys in this book, not only discover the spider's name and rank, but see pictures of her and her mate, and of the web and the great egg-sac, find a short description of the making of the web and other habits, and, if his interest has been stimulated to follow up the references, he will find himself led to practically everything that has ever been written about his subject.

In the art of making keys Kaston is a master and, in the art of illustrating the key-points, his wife is equally adept. Her drawings to the number of nearly a thousand are not only accurate and informative, thus serving their purposes perfectly, but they show that firmness and delicacy of line which characterize the truly superior draughtsman. The total number of line drawings and half-tones in the volume is something over 2,000, the number of items indexed is on the order of 2,300, the bibliography runs to 28 pages (about 500 items), and the glossary covers 10 pages. The introductory matter of about 50 pages discusses, briefly but thoroughly (and with all the references to lead the reader to more complete knowledge), the natural history of spiders, their internal and external anatomy, their parasites and other enemies, their economic importance, and the methods of collecting and study. This section concerns spiders in general and is not limited to the species found in the Connecticut region.

Strictly speaking, this is a technical monograph, not a book for the general reader with scientific interests, but it actually serves all the purposes of both. This is due to the fact that Kaston has organized his material in a masterly fashion and writes about it simply and clearly and keeps steadily to the aim of making his own vast store of knowledge available to the reader, of whatever kind he may be.

WALKER VAN RIPER

ANIMAL GROWTH AND DEVELOPMENT

EMBRYOLOGY. *Dryden Press Publications in the Biological Sciences.*

By Lester George Barth. Dryden Press, New York. $5.00. xiv + 330 pp.; ill. 1949.

It is a rare day when a completely original textbook is published in any field. Such an event took place with the appearance of this small book (330 pages) which represents an expansion of lectures Dr. Barth has been giving to his embryology students for years. As a result its style is concise, its emphasis is dynamic, and non-essential details have been eliminated. The student introduced to the subject by Barth's book will find neither a description of stages of the anatomy of the embryo nor a comparison of the anatomies of different vertebrate embryos. Instead he will find broad principles which determine development as well as many intriguing problems in all phases of the subject.

The approach to the subject is analytical and experimental, with specific experiments cited as illustrations. The scope of the book reflects the breadth of the author's research interests, and includes principles elucidated by coelenterate and flatworm regeneration as well as the more usual subject matter of an embryology course. It is unfortunate, however, from my point of view that nowhere in the text can the interested student find either the name of the experimenter or a reference to the publication in which the work originally appeared.

Of the 194 illustrations in the book, only six come from other texts and two from research publications. Commendable features are the often extensive explanatory legends, the legibility of the labels and the placement of the names of structures rather than abbreviations at the end of lead lines.

The vast majority (118) of the illustrations are diagrammatic. About a third (62) are photographs. The photographs by Moore, Barrer and Zwilling are excellent. However, the quality of almost a half of the photographs leaves something to be desired, either because of excessive reduction as in the case of the cross sections of the chick and pig, or because of the mesh of the screen used in making the half tones.

Barth's use of a large number of diagrammatic illustrations (118) is one of the more unusual features of the text. In my eyes the chief reason for their use is to simplify complex structures and to focus the reader's attention upon important features rather than nonessential details. In Barth's hands, however, there is little attempt to make the diagrammatic drawing of a structure resemble its counterpart in life. Consequently, the reader often is distracted from the main point by attempting to interpret the unnecessarily distorted caricatures.

Lack of attention to detail has resulted in figures

such as the second drawing on page 252 in which one end of the vitelline vessels appears to open into the yolk and the other end into a space under the embryo. This seems to be midgut but extends under the splanchnopleure and is directly connected with the exterior. Such inaccuracies may perhaps be overlooked in lecture presentation. However, text figures which will be carefully studied by the student must be drawn with great pains to insure that no part be misinterpreted.

In a work of this size and scope it is unavoidable that some facts deemed important by the user will be omitted. The reviewer would like to see the very brief discussion of the physiology of the prenatal period expanded into a full chapter. Two excellent books, Smith's *Physiology of the Newborn Infant* and Snyder's *Obstetric Analgesia and Anaesthesia* which contain recent summaries of this subject, could be added to the reference list at the end of the book.

The book is generally free from factual errors. One to which the author's attention is directed is the statement that at term the fetus "is able to maintain its body temperature against low temperature exposures by increasing its rate of metabolism." Recent investigators agree that newborn mammals are essentially poikilothermic.

In the overall picture the criticisms listed above are not serious. The highest commendation that an introductory text can receive is that it stimulates the student. To an unusual degree this is true of Barth's book.

JAMES A. MILLER, JR.

CONTRIBUTIONS TO EMBRYOLOGY. *Volume XXXIII, Numbers 213 to 221. Carnegie Inst. Wash. Pub. 583. Carnegie Institution of Washington, Washington, D. C.* $8.50 (paper); $9.25 (cloth). iv + 186 pp. + 34 plates; text ill. 1949.

Four of the 9 papers contained in this volume of *Contributions to Embryology* are concerned with the early development of the human being. Two recently implanted ova of the pre-villous stage, having a developmental age of about 8 and 9 days respectively, are described by Arthur T. Hertig and John Rock. These specimens, along with 2 others of the pre-villous stage, also obtained by Hertig and Rock several years back, bring the total of these very early embryos up to 4 now available for study. All of these most valuable and rare specimens have been obtained from patients undergoing therapeutic hysterectomy and upon whom pertinent data had been carefully recorded. The 2 specimens described in the present communication lie in series between the 7- and 9-day specimens described previously, and represent the stage of human development when the ovum is well implanted and the uteroplacental circulation is just beginning to function. This important series of 4 recently embedded ova shows most of the phenomena associated with implantation in the human being. The only stages now missing are the first hours after the blastocyst makes contact with the endometrium, and the earliest phases of lacuna formation within the syncytiotrophoblast at the embryonic pole.

Information pertaining to the early development of the skeleton is presented in 2 papers: one by the late George L. Streeter, the other by E. Carl Sensenig. As a section of his survey of the developmental horizons of the human embryo, Streeter has reviewed the genesis and differentiation of the humerus, selected as a typical long bone. By confining attention to one bone and following it through all of its developmental stages the author felt that "one obtains a more complete history of the consecutive factors that play a part in the development of the skeletal system."

Sensenig, in his paper, presents the stages in the early development of the vertebral column. His study includes not only the development of all of the vertebral components, but also the vertebral and costal parts of the ribs and the notochord. This work is based on the examination of serial sections of nearly 100 embryos of the closely graded series of the excellent Carnegie collection.

The fourth and last paper dealing with early human development is one concerned with ureteral and renal anomalies by Lawrence R. Wharton, Jr. He describes 2 young embryos approximately 30–32 days old (ovulation age) showing double ureters and associated abnormalities of the kidneys. An interesting discussion of the embryology of these anomalies, in the light of theories of development of the metanephros, is included.

There are 3 papers on the rhesus monkey, all of which are concerned with portions of the reproductive system. In his study of the rate and significance of atresia of the ovarian follicle, Somers H. Sturgis describes the cytological changes (arbitrarily divided into three stages) which occur in the retrogression of certain follicles undergoing atresia during an ovulatory cycle. A discussion of the possible significance of the timing of atresia and the relation of the early atretic changes to ovulation is presented. Of the 2 remaining rhesus papers, one by Clara E. Hamilton deals with the cervical mucosa, the other by Elizabeth M. Ramsey with the vascular pattern of the endometrium. Hamilton has made a study of the changes in "cellular morphology" of the cervix uteri during the normal reproductive cycle and after the administration of hormones. A large, well graded series of monkeys was used. Estrogen was found to be the dominant hormone affecting the cervix. Glandular development and mucosal proliferation occurred only when estrogen in adequate quantities was administered. A close parallel between the changing levels of blood estrogen and

the height and secretory capacity of the cervical epithelium was demonstrated. The detailed study of the vascular pattern of the endometrium by Elizabeth Ramsey is quite comprehensive. It provides a beautifully consecutive account of the vascular transformations which occur in the maternal placenta from implantation to parturition. While experience has taught readers of the *Contributions* to expect the best in illustrative material, the 5 superb color plates reproduced from half-tone drawings by J. F. Didusch which accompany the text exceed all expectation and deserve very special mention.

Vascular adjustment in the uterus of the rabbit during pregnancy is discussed by S. R. M. Reynolds in an interesting paper entitled Adaptation of Uterine Blood Vessels and Accomodation of the Products of Conception. He finds that uterine accomodation involves a predictable and characteristic series of morphological and physiological adaptations on the part of the uterine tissues about a conceptus. Diffusible dyes and plastic injection-corrosion preparations have been used to great advantage in producing revealing evidence.

The ninth and last paper to be mentioned is one by Adolph Schmultz that deals with the palatine ridges of primates. A survey of the main characters of these ridges shows that the original conditions have become significantly changed in many groups and that these alterations reveal definite phylogenetic trends. The rugae have not become as extremely modified in the primates as in some of the other mammalian orders. Schultz's study supports the conclusion that the number, arrangement, and relative sizes of the ridges remain unchanged throughout growth in man, just as in other primates.

MARY E. RAWLES

HUMAN GROWTH: *The Story of How Life Begins and Goes On.*

By Lester F. Beck. Harcourt, Brace & Co., New York. $2.00. 124 pp.; ill. 1949.

This book is perhaps unique in that its publication follows rather than precedes its movie! Whatever may be said of the film original (and the publishers claim that it "has been received with overwhelming praise from coast to coast"), this book does an excellent job of presenting the story of human reproduction and growth to a junior high school audience. The text is notable for clear, accurate, straightforward, and eminently sensible treatment of its subject. It is well illustrated, although the illustrations are highly schematized, being in many cases quite frankly diagrams, yet diagrams that tell their store in a dignified and clear manner.

Those familiar with an earlier book on the same subject, *Life and Growth* by Alice V. Keliher, cannot help but be struck by the great similarity between the two. This similarity becomes all the more interesting and important when it is realized that apparently each book was produced independently. Although Alice Keliher's book was aimed at a senior rather than at a junior high school level, and set in a wider frame of reference, both books are the outcome of long planning and study on the part of many individuals: parents, teachers, biologists, physicians, and students themselves. Both use schematic illustrations—a far cry indeed from anything in Dickinson's *Sex Anatomy* but still effective and appropriate for the intended readers. Both books emphasize the paramount importance of the entire personality, including love, in sexual relationships. Both answer with directness, simplicity, and an abundance of common sense a great multitude of questions that arise in the minds of teen-agers. Both stress the fact that human beings can and do differ enormously in size and shape and in the age at which sexual maturity begins, as well as in numberless other ways, and yet can be perfectly normal. Both omit consideration of birth control.

Reading these competent, straightforward books, the reviewer had the feeling that if Reginald the office boy (who used to comment especially upon books on sex in these pages) were to happen upon these volumes, he would be disappointed. Although they are concerned primarily with sex education, and are informative and honest in performing their task, it may well be doubted whether there is anything here that would have shocked Queen Victoria herself (though it would have shocked those of her contemporaries who preferred ignorant or misinformed snickers to informed and intelligent respect).

GAIRDNER B. MOMENT

ANIMAL MORPHOLOGY

ANATOMY AND PHYSIOLOGY LABORATORY GUIDE. *Fifth Edition.*

By Edmond J. Farris. J. B. Lippincott Co., Philadelphia, London, and Montreal. $2.50 (paper). xvi + 146 pp. + 3 pamphlets; text ill. 1949.

This is an adequate manual for use in anatomy and physiology courses designed for nurses, particularly in those institutions where laboratory equipment may be limited.

DAVID B. TYLER

HUMAN SEX ANATOMY: *A Topographical Hand Atlas. Medical Aspects of Human Fertility Series Issued by The National Committee on Maternal Health. Second Edition.*

By Robert Latou Dickinson. Williams & Wilkins Co., Baltimore. $10.00. xiv + 145 pp. + 193 plates. 1949.

With the exception of the one mentioned below there are only a few small changes or additions to this edition as compared with the first edition published about 17 years ago (*Q.R.B.*, 9:251). I note on page 107, in the section on "Coital Postures; Instruction," the same footnote that appeared in the first edition:

> "Our advisors deem the medical profession as yet unready for this chart. In order, therefore, that there may be no inequality between purchasers of the early and a possible later printing, a slip is enclosed for forwarding to the publishers, to be accompanied by a request from the physician on his own letter paper, for such page or pages, if and when published.'

This was a sore blow to many a practitioner's professional pride, and it is said that some have not yet fully recovered from it. But they may now take heart, for the chart in question is incorporated in this edition as Figures 159C and D, which are comprised of some 13 outline drawings. These should have wide appeal for, as the author said, "without grace and intensity one may not delineate ecstasy, so the high art of Greece and Florence were made the exemplars, with realism subordinated to design."

I know there are many who claim that the medical profession is at least 50 years, or more, behind the times, particularly behind science. However, I believe that such sceptics are carrying it a bit too far when they raise doubts as to whether or not the doctor is at this date still unready to look upon figures that are examples of the high art of Greece and Florence. After all, let's be fair about this!

DAVID B. TYLER

COMPARATIVE ANATOMY LABORATORY MANUAL.

By Lloyd Raymond Gribble. The Blakiston Co., Philadelphia and Toronto. $3.00. xii + 231 pp.; ill. 1950.

This book is prepared on the systematic basis, each of 8 chapters offering a discussion of an organ-system, exemplified by 4 to 7 vertebrate forms. Chapter 1 deals briefly with amphioxus as a chordate type. The 41 pages of beautiful, unlabeled drawings are crowded, sometimes 12 to the page, and are not referred to by reference numbers or otherwise identified in the text. The final chapter is an interesting and valuable study of Anomalies and Variations in the Cat, based on the 18 years' experience of the author in examining over 900 specimens.

JOHN A. CAMERON

ATLAS OF DRAWINGS FOR CHORDATE ANATOMY.

By Samuel Eddy. John Wiley & Sons, New York; Chapman & Hall, London. $3.50. xii + 150 plates. 1949.

The handsome and clear outline drawings here are well spaced on 8½ x 11 in. heavy paper. Forms included are *Amphioxus, Molgula,* Ammocoetes larva, Dogfish Shark, *Necturus,* Turtle, Pigeon, and Cat. The perforated pages can be removed in any order and arranged in a loose-leaf binder for comparison or review.

JOHN A. CAMERON

THE DISSECTION OF THE SHARK. (*The Dogfish, Squalus acanthias.*) A *Laboratory Manual. Revised Edition. By Bruce M. Harrison. Burgess Publishing Co., Minneapolis.* $1.50 (paper). v + 54 pp.; ill. 1949.

This manual provides detailed directions for the systematic study of the shark, including a bibliography of 16 titles. Twenty-nine black and white figures provided with label lines, but not labeled, are included at convenient places and printed on separate perforated pages. A perforated set of review questions, with space for answers, follows each section of the directions. This should be a time-saver for student and teacher alike.

JOHN A. CAMERON

AN ATLAS OF CAT ANATOMY.

By Hazel E. Field and Mary E. Taylor. University of Chicago Press, Chicago. $3.75. 75 pp. + 57 plates. 1950.

Here is an original and attractive approach to an old subject. The plates, mostly life size on 10 x 12¾ in. pages, show limited regions of the body of the cat, with prominent key numbers referring to the nomenclature on the same page. In the upper left hand corner of each page is a small orientation sketch of the entire cat with the area of the plate marked off. On the page opposite the plate is the explanatory material. No directions for dissection are given, although ample unused white space is available opposite the plates. There are an excellent pronouncing glossary, a short reference list, and an adequate index.

JOHN A. CAMERON

FUNCTIONAL HUMAN ANATOMY: *An Introduction into the Fabric of the Human Body.*

By Cleveland S. Simkins. Wm. C. Brown Co., Dubuque, Ia. $12.00. x + 593 pp.; ill. 1949.

There are numerous published works whose purpose is to interpret gross anatomy in such a way that it will reach the student alive, dynamic, and provocatively

interesting. Almost every conceivable approach has been used to accomplish this purpose. Such presentations are usually expressions of the individual author's conviction that the task is best accomplished by developing in the students' minds certain trains of association likely to liven the subject material. Sound scholarly background, well disciplined organization of material, and the rare ability to interpret freely without loss of accuracy are the essential requirements of such a venture. The volume under consideration falls so far short of the mark that it cannot be taken seriously.

Inaccuracy in statement of anatomical fact is inexcusable in view of our well established knowledge of the subject, yet this book is full of inaccuracy. For example: the layers of the retina, listed from within outward, include (p. 186) ". . .3, inner plexiform layer; 4, inner nuclear layer; 5, bipolar cells; 6 horizontal cells; 7, amacrine cells; 8, outer plexiform layer; . . ." Terminology is used so loosely that a single structure may be called by several different names, some of which, by definition, include other parts or only a part of the structure in question. The grammar, throughout, is so poor that the reader with some knowledge of anatomy is forced to unscramble vague antecedents, bad punctuation, and misprinted words in almost every paragraph. The well-reproduced illustrations are mostly neat, original line drawings, but labeling and anatomical representation are frequently inaccurate. The book is planographed in double columns on poor paper. It is cloth bound. This book is, to all appearances, earnestly conceived, but the fact that it has been published at all is most unfortunate. It cannot be recommended for any level of instruction.

F. N. Low

SHEARER'S MANUAL OF HUMAN DISSECTION. *Second Edition.*

Edited by Charles E. Tobin. Blakiston Co., Philadelphia and Toronto. $4.50. xvi + 286 pp.; ill. 1949.

The publishers of a successful book are in a ticklish spot. As the years go by it becomes criticized for being out of date or old-fashioned, no matter how factual its subject matter. Yet radical changes in contents and format may cost old friends without gaining new. In this connection, both Tobin and the Blakiston Co. are to be congratulated. Skillful facelifting has apparently rejuvenated this well-known manual without having made any substantial changes. One learns from the preface that the changes and alterations are designed to serve eight vaguely categorized purposes. Among them, altered dissection procedure will show certain structures to better advantage, and added illustrations will supplant the original text and illustrate the new dissections. There are still 79 figures. Fifty are the same with the same numbers, 24 are the same with new numbers, and 5 are new, 1 of which (fig. 15) was modified from Sobotta-McMurrich. Last among these purposeful alterations is the introduction of "new anatomical concepts which have been developed since the first edition (1937) was written." The critical evaluation of this little gem is left to others.

The wisdom of using a dissector in gross anatomy is much debated. To most of those who must teach it or learn it, the subject looms impossibly large and unwieldy, something to be gotten out of the way as expeditiously as possible. Its very magnitude invites short cuts and sugarcoating. A dissector provides these for both staff and student. In the volume under consideration, for example, bold type is used for the more important structures. This spares students the agonizing labor of underlining these themselves and provides them with more concrete evidence that they can't possibly be expected to know things that aren't in the book. The italicized advice of the preface, to use the manual as such with supplementary collateral reading, is largely a cry in the wilderness, all the more since the presence of the dissector discourages rather than encourages such procedure. On the other hand, the regimented demands of modern medical education make the study of gross anatomy by self-propelled curiosity, essentially in the manner of original investigation, an almost impossible task. Most students are not equal to it, and the problem of arousing their interest, maintaining it, and finally molding it into interpretative patterns is a task beyond the capacities of most departments, now so largely understaffed. The popularity of a dissector is understandable. The early success of this manual has shown it to be a practical solution, however bad in the pedagogical sense, of a vexing teaching problem in anatomy. The close resemblance of the present edition to what has gone before should insure its continued use. No friends will be lost and some may be gained.

F. N. Low

PRACTICAL ANATOMY. *Second Edition.*

By W. E. Le Gros Clark. Williams & Wilkins Co., Baltimore. $6.00. xvi + 493 pp.; ill. 1949.

This dissecting manual, although published from this country, was printed in Great Britain. It is a second edition with unaltered scope but improved illustrations. The approach is by body regions. Dissection instructions are interwoven with descriptive passages in which the structures to be studied are printed in bold type. Each section closes with italicized instructions for supplementary study. The whole body is covered in the usual manner. The various major sections are interchangeable, but the prescribed procedure is rigid rather than flexible. Gross dissection of the brain (in a separate section) and the spinal cord (with the head and neck) are included. Microscopic neuroanatomy is not touched upon, and physiological interpretation is re-

stricted to grossly visible parts. There is great variety in the illustrations, among which are line drawings with or without color, half tone and color reproductions, and photographs. They have been chosen primarily to illustrate the area being studied, and do this well, but represent a strange assemblage of styles. In keeping with the high status and abundant publications of the author this volume is well written, accurate, and thorough, without being at all exciting or new in its approach. It is safe and solid, and is recommended to all who can use a handbook of dissection about 500 pages long.

F. N. Low

Applied Anatomy and Kinesiology. *The Mechanism of Muscular Movement. Sixth Edition, Revised.* *By Wilbur Pardon Bowen; edited by Henry A. Stone. Lea & Febiger, Philadelphia.* $4.75. 390 pp.; ill. 1949.

This book is an interesting application of basic biological science to a practical although somewhat restricted field. It is designed chiefly for the field of physical education. It should be useful to anyone interested in the analysis of body mechanics. The 6 chapters of Part One, dealing with general principles, are well written. They are clear, with accurate presentation of basic material from a number of fields. They are up to date, each containing a remarkably well selected bibliography. Especially noteworthy is the addition of a chapter on the chemistry of muscular action, which many physiologists might do well to read. Parts Two through Five deal with movements of various parts of the body, regionally considered, and their integration. The last part, on general kinesiology, covers posture, walking, running, jumping, games, sports, and body mechanics of everyday occupations, these analyses largely replacing the sections on formalized Swedish exercises included in previous editions.

The logical presentation of material makes the book as a whole commendably purposeful. After a clear presentation of fundamentals the principles and facts are woven together, first in the simple patterns of regional body mechanics and then into more complicated manifestations. The readily understandable mechanics of walking and running are followed by more and more complex patterns, such as those of the body contact sports. The anatomical plates are old, mostly from Gerrish and Gray, but are clearly reproduced and accurate. Photographs of living models and athletes add much to the clarity of the text, which is written at the college student level of comprehension. Coaches and teachers of physical education should find little fault with this carefully prepared book. It makes an interesting addition to the library of anyone interested in the mechanism of muscular movement.

F. N. Low

Outline of Histology. *Second Edition.* *By Margaret M. Hoskins and Gerrit Bevelander. C. V. Mosby Company, St. Louis.* $3.50 (paper). iv + 116 pp.; ill. 1948.

This planographed, loose-leaf book bound in plastic is apparently intended for use in dental schools, since it has been prepared by members of the Dental Faculty of New York University and emphasizes dental histology and embryology. The acceptably accurate text is accompanied by drawings, mostly black and white, with blank pages interspersed for notes. The style is clear and the terminology accurate.

Too long to serve as a laboratory manual and too short for a textbook, it represents an "in-between" sort of volume. It is good of its kind. It should be useful in courses which are not designed to develop an inquiring or particularly aggressive type of scholarship in the students.

F. N. Low

ANIMAL PHYSIOLOGY

Recent Advances in Physiology. *Seventh Edition.* *By W. H. Newton. Blakiston Co., Philadelphia.* $4.50. viii + 268 pp.; ill. 1949.

Newton says it very nicely when he refers to the old schoolmaster who apparently delighted in pointing out that *The Acts of the Apostles* should have been called "Some Acts of Some Apostles" and adds that this text book might be justly called "Some Recent Advances by Some Physiologists."

There are no shortages of reviews and monographs in physiology. With the abundant material available, the problem of the average teacher and biologist is which to read in the time at his disposal. This edition of *Recent Advances in Physiology* may be considered a well done review of reviews, even though the subjects covered are fewer than in previous editions. It will unquestionably be a valuable source of information as to recent trends in the fields of the physical basis of temperature regulations, water diuresis, digestion, the physiology of pregnancy, blood pressure and the kidney, catheterization of the heart, electrical excitation of nerve, cutaneous sensation, auditory impulse, and color vision, and can be recommended unhesitatingly to students and teachers alike.

David B. Tyler

Textbook of Human Physiology. *Second Edition.* *By William F. Hamilton. F. A. Davis Co., Philadelphia.* $7.00. xv + 625 pp.; ill. 1949.

The problem of recommending a textbook of physiology for medical students becomes increasingly difficult with each passing year. Not that there is a dearth

of good textbooks. Quite the contrary, there are some truly first rate ones in this field. Most teachers of physiology, particularly in the medical school, prefer that students purchase one of the larger reference textbooks. However, many, aware of the impossibility of expecting students to read and digest completely such textbooks during the course, design their lectures to give the students an understanding of the fundamentals. Among other instructors there is a preference for compact, small textbooks that stress principally the fundamentals. In recommending these, they are of the opinion that their use increases the chance of imparting to the future physician an understanding of the fundamental physiological mechanisms. In many departments, the professors try to arrange, where possible, for lectures to be given by specialists in the various subjects. Probably the most common practice is to suggest that each one in a group of 4 or 5 students (generally a laboratory group) should purchase one or the other of the preferred major textbooks of physiology, so as to assure that the students of a laboratory group have access to at least one of the larger reference books as well as to one of the smaller books.

Hamilton's textbook (1st ed., *Q.R.B.*, 24: 157) is an excellent sample of a smaller textbook of physiology that stresses in the simplest manner the general principles of human physiology. On the basis of readability, accuracy, original and good illustrations, suitable bibliography, and adequate indexing, it can be highly recommended. More and more instructors of the subject are using it as the principle textbook, to be supplemented by readings from the larger reference books (or by lectures by experts in various fields). This edition is slightly longer than the first, and it is probably unavoidable that it should contain some minor errors of fact. These are not serious and should not detract from the value of the book, for undoubtedly they will be quickly picked up and brought to the attention of the author. There is a new chapter on the physiology of the circulation in congenital heart disease, and the implications of the physiological principles are adequately discussed. I for one believe that the library of a medical student should contain 2 textbooks of physiology, one such as this and one of the more exhaustive reference books.

DAVID B. TYLER

PHYSIOLOGY IN HEALTH AND DISEASE. *Fifth Edition.*
By Carl J. Wiggers. Lea & Febiger, Philadelphia.
$10.00. 1242 pp.; ill. 1949.

This edition has been thoroughly revised (cf. *Q.R.B.*, 20: 284). Approximately one-third of the text has been entirely rewritten, some 60 new illustrations have been added, and over 1,000 new references included. There is an entirely new chapter dealing with the physiological basis for psychosomatic reactions (not as bad as it sounds) in which are discussed emotional centers in the central nervous system, cortical factors and emotional reactions, the purposiveness of emotional reaction, the effects of non-utilization of visceral energy releases, and the functional changes due to emotions. Also included in this chapter is a section on human organ neurosis containing discussions of neurological disorders of the digestive tract, cardiovascular neurosis, respiratory and skeletal muscle neurosis, and somatopsychic interrelations. The entire chapter is sound and impartially presents some of the common premises in this very controversial field.

Wiggers has done considerable revision and extension, particularly in biophysical subjects, items of special clinical concern, such as pain, headache, paralysis, spasticity, coagulation and anti-coagulation, blood volume, coronary occlusion, hypertension, and other similar subjects. Still retained in this edition is an extensive discussion of various phases of aviation medicine and other aspects of war medicine and physiology.

DAVID B. TYLER

STARLING'S PRINCIPLES OF HUMAN PHYSIOLOGY. *Tenth Edition.*
By C. Lovatt Evans; chapters on the Special Senses by H. Hartridge. Lea & Febiger, Philadelphia. $10.00.
xii + 1193 pp. + 6 plates; text ill. 1949.

This edition is only 39 pages longer than the Ninth (7th ed., *Q.R.B.*, 12: 120) and the increase is primarily due to the inclusion of about 60 new illustrations. As in the Ninth Edition, most of the principal subjects are introduced with a short historical discussion, a very desirable feature, which should serve to orient the beginner in the development of the subject to its present form. There has been some revision or condensation, particularly in the chapters dealing with biophysical principles, the autonomic nervous system, the chemistry of respiration, and the special senses.

DAVID B. TYLER

SHOCK AND ALLIED FORMS OF FAILURE OF THE CIRCULATION.
By H. A. Davis. Grune & Stratton, New York.
$12.00. xii + 595 pp.; text ill. 1949.

This important monograph is a comprehensive exposition of the clinical states commonly grouped under the term shock and of the known physiological, biochemical, and pathological changes occurring in shock. It is written primarily for the physician, and the extensive data are descriptive, with sections on toxemias and infections, medical and obstetrical shock, anesthesia, burns, thoracic disturbances, the circulatory weakling, and the treatment of shock. The chapter on irrever-

sible shock deserves special notice. Some of the material is presented dogmatically, but in general the volume constitutes a well annotated discussion of the entire subject. The introductory chapters review circulatory failure from an historical point of view, present the author's concept of shock, and discuss the validity of the varying theories of pathogenesis. Denying many of the well known limited theories of shock, such as that the urticarial wheal is shock in miniature (Moon), the author proposes the following broad descriptive definition: "Shock is a state involving the entire organism, characterized by a generalized impairment of the circulation, and caused by any form of stress or injury which reduces the output of blood from the left ventricle of the heart to a level below that needed for normal cellular function and metabolism." He convincingly elaborates the concept that "the final result of all forms of stress, if sufficiently severe, will be anoxia of varying degree," and classifies the specific changes occurring in shock into three phases of cellular change (the "triphasic response"): (1) a period of anoxic injury to cells, (2) a period of catabolic cell breakdown, and (3) a period of anabolic cell repair. This differs from Selye's better known "shock and countershock" theory, primarily in that it distinguishes between the phenomena of injury and the homeostatic response of the organism to injury, and it appears to be a valid working concept. This introductory section is ably written and comprises nearly half the volume.

E. Converse Peirce, 2nd

The Honeybee. *An Introduction to her Sense-Physiology and Behaviour.*

By C. G. Butler. Oxford University Press, New York (printed in Great Britain). $2.50. vii + 139 pp. 1949.

"The Bees are probably best regarded as wasps that have forsaken a carnivorous diet in favour of a vegetarian one and whose structure has undergone various modifications which enables them to collect nectar and pollen very efficiently." Careful consideration is given to the worker honeybee, tracing the chronological changes in her role as a member of the hive community. The literature on color vision, form perception, hearing, time sense, smell, and taste is analyzed succinctly and in excellent balance. The bee's activities in collection of propolis, water, pollen, and nectar receive separate treatment, following which the behavior of the honeybee in the field is reviewed briefly by way of summary. This little book performs a major service in drawing together the scientific studies that have been made on the most complex of social insects. The references are not exhaustive but are well selected. Together with the thoughtful summary itself, they should do much to counteract the poetic and anthropomorphic interpretations of honeybee activitv, and allow a saner middle course to be steered by those who should know more about pollinators and honeymakers.

Lorus J. & Margery J. Milne

Physiology of the Eye. *Volume I. Optics.*

By Arthur Linksz. Grune & Stratton, New York. $7.50. xii + 334 pp. 1950.

This first volume of a set of three in preparation is concerned solely with optics. The contents are divided into 3 broad sections dealing with the physics of light (5 chapters), geometrical optics (8 chapters), and the eye as an image-forming mechanism (3 chapters). The author is a practicing ophthalmologist and a lecturer in ophthalmology at various hospitals in New York City. These qualifications undoubtedly explain why this is such a readable book on physics. A considerable amount of difficult, technical information is presented by an author who is obviously sensitive to the needs of students who are neither mathematicians nor physicists. There are over 100 excellent illustrations prepared especially for this book. Unfortunately, there are no headings within chapters to relieve the monotony of solidly printed pages, to help the reader follow the outline of the chapter, or to serve as landmarks for the reader who wants to backtrack to earlier sections. Perhaps the author will correct this deficiency in the next volume.

A. Chapanis

Hormones in Clinical Practice.

By H. E. Nieburgs. Paul B. Hoeber, New York. $5.50. xi + 388; ill. 1950.

Nieburgs has tried to give the practitioner "a fresh evaluation of therapeutic procedures involving the use of hormones or directed to a correction of endocrine disturbances." He has not been too successful in accomplishing his aim. One of the best established therapeutic uses of hormones is undoubtedly the substitution therapy of cretinism with thyroid hormone. The effects on physical growth and development are striking in practically every case of cretinism treated this way. No mention of these changes nor of the adequate dosage of thyroid hormone in the treatment of cretinism can be found in Nieburgs' book. The author states that the most conspicuous result of the treatment of cretins was an acceleration of psychological activity. This is contrary to the current thought in pediatric endocrinology. The statement that "removal of either the thyroid or the parathyroid gland is followed by hypertrophy of the other" will hardly be acceptable to most endocrinologists. The book suffers from the use of uncommon terms which are introduced without adequate definition. This reviewer is at a complete

loss to understand the term "pseudo-dwarfism." The best part of the book is the chapter on diagnostic procedures, which should prove of great help in the endocrine clinical laboratory. Another good feature is the inclusion of radiographs of the wrist for the estimation of osseous maturation. The book is recommended for the advanced student of endocrinology, who will find some stimulating ideas in it.

W. FLEISCHMANN

PHARMACOLOGY AND TOXICOLOGY OF URANIUM COMPOUNDS. *With a Section on the Pharmacology and Toxicology of Fluorine and Hydrogen Fluoride. National Nuclear Energy Series, Manhattan Project Technical Section. Division VI—Volume 1, Parts 1 and 2.* *Edited by Carl Voegtlin and Harold C. Hodge. McGraw-Hill Book Co., New York, Toronto, and London.* $10.00 (Two parts, not sold separately). (1) xviii + Pp. 1–524 + 11 plates; text ill. (2) iv + Pp. 525–1084 + 2 plates; text ill. 1949.

This volume summarizes approximately 3 years of research by a large group of investigators working at the University of Rochester Project on the toxicology of uranium. This Project was a division of the larger Manhattan Project of the Atomic Energy Commission. There are 29 contributors to the volume. The results of this comprehensive study stand as the most complete experimental investigation of an industrial poison ever carried out by any group of scientific workers in such a relatively short time.

The subject is divided into two parts, not identical with the two books, however. Part I deals with the pharmacology and toxicology of uranium compounds. Part II is concerned with some observations on the toxicity of fluorine and hydrogen fluoride (40 pages). A number of the uranium compounds employed in the production of atomic energy were evaluated for their toxic qualities. Emphasis was placed on the mechanism of action of uranium. The physicochemical rules which govern the formation of uranium-protein complexes and bicarbonate complexes are applied to the transport of uranium in the body and its excretion by the kidney. Histological as well as biochemical studies were made. Many of the methods and techniques are given in detail, with extensive use of charts, tables, and photographs. The authors claim that many new methods for evaluating uranium toxicity are included, e. g., skin and eye toxicity, inhalation toxicity, distribution and excretion with analytical methods, enzyme and protein effects, and others. The volume is divided into 17 chapters, with an extensive index of 15 pages, and is very well bound and printed. The color plates of histologic sections are excellent.

It is exceedingly difficult to predict the extent of usefulness of a contribution of this kind. The number of investigators directly concerned with the toxicity of uranium compounds is unknown to the reviewer. However, the volume sets forth a pattern of study that may be copied with profit by other workers concerned with the toxicity of other agents. In this regard it stands as a classic.

C. JELLEFF CARR

THE BIOLOGY OF HUMAN STARVATION. *Two Volumes. By Ancel Keys, Josef Brožek, Austin Henschel, Olaf Mickelsen, Henry Longstreet Taylor, with the assistance of Ernst Simonson, Angie Sturgeon Skinner, and Samuel M. Wells, with forewords by J. C. Drummond, Russell M. Wilder, Charles Glen King, and Robert R. Williams. University of Minnesota Press, Minneapolis; Geoffrey Cumberlege, Oxford University Press, London.* $25.00. Vol. I: xxxii + Pp. 1–763; ill.; Vol. II: viii + Pp. 764–1385; ill. 1950.

In these two volumes are recorded in detail the results of the "Minnesota Experiment" on human semi-starvation, as well as a rather complete and critical evaluation of the literature dealing with this aspect of nutrition. There are some similarities between this study and one performed some 20 years earlier by Benedict and his co-workers at the Carnegie Nutrition Laboratory. Both were concerned with the effects on humans of underfeeding and both were started as a result of wars. It is also true that many of the biochemical, physiological and psychological procedures employed were common to both. But that is about as far as the similarity goes. The Carnegie experiment, although originally planned to study semi-starvation, actually investigated the effects of slight underfeeding to the extent that the diet employed caused a 10 per cent reduction in body weight. When this reduction was brought about the food intake was then adjusted so as to maintain the new weight for a relatively short period of time. Furthermore, the food eaten was essentially the same as that consumed every day by normal, healthy Americans except that the caloric intake was restricted so as to being about the above condition. To be sure, the men were hungry and did not gain weight on the regime but there is no indication from the results that they suffered from semi-starvation. In fact, with our present knowledge of nutrition one might not err much in predicting that if the Carnegie study had been extended long enough (and controlled better) it might have revealed data on the beneficial effects of *slight underfeeding* and *controlled underweight* as compared with the *overfeeding* and *overweight* conditions so typical of a large portion of the adult population in this country.

The "Minnesota Experiment," on the other hand, was carried out under experimental diets that produced frank semi-starvation and a 25 per cent loss in body weight. The overall picture in the subjects resembled

fairly closely the nutritional conditions found in famine areas, in concentration camps, and in other situations where drastic underfeeding exists. As in all human experiments the results left much to be desired, but such criticism is hindsight and such lacunae, where they occur, are certainly not due to poor planning on the part of the Minnesota group. Human, in contrast to animal experimentation, does not lend itself readily to repetition, particularly when the research is long term and involves definite hazards to life. Such desirable information as the Minnesota group failed to obtain in their research may serve as a project for other investigators. Just as the Minnesota group profited by the Carnegie's omissions so (it is hoped) will future research groups profit by theirs.

It cannot be argued that animal experiments can supply essentially all the data applicable to humans. Experience teaches us differently. It is axiomatic in science that conclusions cannot be safely drawn on the effect of certain conditions on a given animal species unless supported by well controlled experimental data. If human experiments confirm certain findings obtained by animal studies—well, that is what we demand of the scientific method.

It appears to this reviewer that a recent criticism (*Science*, 112:657, 1950) of the work of the Minnesota group indicates incomplete information on the differences in the results of the Carnegie and Minnesota studies, as well as some unawareness of the difficulties that are involved in carrying out human experiments. Those who have had experience in conducting experiments on man, particularly under hazardous conditions, can well appreciate the trials and tribulations that confronted the Minnesota group. They are to be commended on carrying out a very difficult and trying study which has produced much valuable information on the biochemical, physiological and psychological effects of semi-starvation. They have also prepared an exceptionally well written and critical treatise of the literature on this aspect of human nutrition.

DAVID B. TYLER

SEXUAL ENDOCRINOLOGY OF NON-MAMMALIAN VERTEBRATES. *Monographs on the Progress of Research in Holland During the War.*

By L. H. Bretschneider and J. J. Duyvené De Wit; in collaboration with S. Dudok De Wit, B. Van Egmond, M. A. Goedewaagen, H. Heintzberger, J. Van Iersel, Chr. Jaski, E. Van Koersveld, I. Kristensen, J. Meltzer, G. J. Van Oordt, and C. Pelsma. Elsevier Publishing Co., New York, Amsterdam, London, and Brussels. $2.75 (paper). x + 146 pp.; ill. 1947.

In spite of the ever-growing burden of oppression and starvation due to the German occupation, research was continued intensively in Holland during the second World War. The Working Community for Endocrinology, Utrecht continued its activities during the 5 years of occupation. "As a token of the undaunted spirit of the Netherlands" the results of this work are now being published as an attractively printed monograph. The test animal used by the authors for their studies of the comparative endocrinology of the reproductive system is the bitterling, *Rhodeus amarus*. The bitterling is a Cyprinid fish, found fairly generally all over continental Europe. At spawning time the female develops a plainly visible urogenital papilla, the ovipositor, with which it lays its eggs in freshwater mussels of the genera *Unio* and *Anodonta*. Before and after spawning this tube shrinks to a hardly visible nipple. Some years ago this reviewer and Miss Kann found that the ovipositor can develop at any time into a long tube if folliculoid or corticosteroid hormones are added to the aquarium water. Bretschneider and Duyvené de Wit have expanded these observations to an exhaustive analysis of this phenomenon. The ovipositor test is especially suited according to the Dutch authors to the demonstration of small amounts of progesterone. Furthermore, the presence of a substance not corresponding to any of the known steroids was demonstrated in human urine. The name of luteidin has been given to this substance, which is secreted cyclically by non-pregnant women. Excretion is at its peak during the corpus luteum phase of the menstrual cycle. During the whole period of pregnancy the secretion of luteidin remains constant at about the same level as during the corpus luteum phase of the menstrual cycle. For this reason the authors feel that the ovipositor test is not suitable for the diagnosis of pregnancy. Most elaborate studies have led the authors to a full understanding of ovarian function in the bitterling. These included histological studies of the ovary and hypophysis during the various stages of the sexual cycle of this fish. A brief discussion of the sexual cycle of the viviparous fish, *Zoarces viviparus*, follows. Even if this research had been carried out under the most favorable conditions it would command our greatest respect. Considering the distressing circumstances under which this investigation was carried out it is a shining example of what true scientists can accomplish if they have the moral and physical fortitude necessary to retain their freedom of thought in the presence of a ruthless occupation.

WALTER FLEISCHMANN

PHYSIOLOGY OF THE UTERUS. *Second Edition.*

By S. R. M. Reynolds. Paul B. Hoeber, Medical Book Department of Harper & Bros., New York. $12.50. xxii + 611 pp. + 1 plate: text ill. 1949.

This second edition of Reynolds' treatise appears some ten years after the original edition (*Q.R.B.*, 15: 104. It is considerably enlarged due to the addition of several new sections as well as to the inclusion of

considerable new data appearing in the literature in the ten-year interim. The book contains over 600 pages and well over 2000 literature references. Its format is superb, printed in large, clear type, profusely illustrated and attractively bound. The publisher is to be congratulated on a remarkable job; scientific treatises are all too often repellent victims of low-grade "utilitarian" press-work, but here the dignity and beauty of the publication invite perusal.

The invitation to read extended by the print and format is happily rewarded by the text itself. Reynolds writes with arresting vigor and enthusiasm. He marshals his material with skill and insight. His book is no mere compendium, but a critical searching appraisal of what we know and need to know about the physiology, biochemistry and pathology of the uterus. The remarkable organization of the subject matter and the skilful transitions from topic to topic make for a smooth flow of reading and sustainment of interest.

There are eight major sections to the book concerned, respectively, with: Patterns and Functions of Uterine Motility, Hormone Control of the Myometrium, Uterine Growth, Circulation in the Uterus, Metabolism in the Uterus, Innervation of the Uterus, Utero-Somatic Relationships and the Onset of Labor. Thirty-seven chapters contain the material of these various major sections; they consider every conceivable aspect from human topography, to steroid hormones during pregnancy, to patterns of uterine growth, to menstruation, to the effects of hysterectomy and so on. It is, of course, impossible to review them in any detail. For one, the specific data are so comprehensive and the number of problems discussed so numerous that their mere enumeration would be a major cataloguing effort. In the estimate of the reviewer the book has certain major merits and a few very minor defects. The statements that follow, therefore, are to be regarded as summary animadversions and critical "highlighting."

Outstanding to me is the succession of genuinely critical discussions of a number of problems. Instead of merely listing pros and cons in the literature, Reynolds gives a searching evaluation of controversial studies. This is exemplified by his examination of various studies of the motility of the human uterus especially in relation to attempted correlations with ovulation time. His analysis reveals that various investigations purporting to contradict the pioneer work of Knous in this field are in fact not controverting, not because the data are "wrong," but because certain simple physiological responses of the uterine musculature to tension and pressure have been ignored. Again in his discussion of uterine tissue growth Reynolds gives a picture not merely of the familiar endometrial changes, but, by careful evaluation of often-ignored scattered findings, emerges with clear evidence for an ordered, integrated development of all uterine tissues. And his search and balanced presentation of the facts of menstrual bleeding lead to a concise, logical exposition of the merits and demerits of various theories of menstruation.

The second striking feature of Reynolds' presentation is the versatility of his approach to various problems. Thus uterine physiology to him is not simply textbook physiology applied to the uterus and related structures. It involves considerations of hydrostatics, of the application of laws of tension derived from the study of rubber balloons, of the genetics of size, and of the biochemical consequences of hyperemia. The beautiful dissections of uterine blood vessels are not taken merely as demonstrations of morphology but also as channels in which the dynamics of blood flow must be explained. Even in the discussion of problems of therapeutics he brings to bear in a remarkable synthesis the nature of action of drugs, biochemical mechanisms in the affected tissue, and considerations of the physics of the tissue components. Again and again the organismal aspects of various uterine functions are established from a variety of superficially unrelated studies.

Finally to the critical acumen and the synthetic skill of the presentation there is added a scholarly grasp that is intellectually most pleasing. I refer not merely to his encyclopedic knowledge of the literature, but to Reynolds' ability to give this knowledge a balanced presentation. There is too often a tendency in latter-day treatises to present a subject as if the last ten or fifteen years have yielded the only meaningful data. Reynolds justly goes to the source material, regardless of date, which gives relevant and meaningful data and skilfully orients it. He recognizes that Dickinson's illuminating observations of the movements of the human uterus in the course of the menstrual cycle are, despite the absence of measuring devices, acute scientific data. The Reverend Houghton's classic observations on the nature of the muscular forces operative in parturition are not dismissed merely with a reference number but are in fact recognized as still the most definitive despite an 1873 publication date.

I have spoken of minor defects. Reynolds' encyclopedic acquaintance with the general field sometimes leads to disquisitions that are not precisely concerned with uterine physiology. Thus a most illuminating discussion of peripheral-vascular responses to estrogens and progesterone (in part IV) loses touch a little with the problem of uterine vascular relationships. Similar discursiveness occurs elsewhere, but so interestingly presented that it is forgiveable. Again Reynolds would have done well to have his remarks on steroid chemistry and biochemistry read by one somewhat more expert in this field. He would then have avoided such frank errors as: "the chief points of similarity between estrone and testosterone are in the fourth sterol ring. This contains a chemically active *ketone* moiety at the seventeenth carbon position" (p. 92). Testosterone is not a 17-*ket*osteroid. In declaring that specific tests for determining progesterone in the blood and urine

are lacking Reynolds ignores the beautiful demonstration by Hooker and Forbes of their highly specific bioassay. His discussion of steroid-inactivating mechanisms seems to me a little superficial, and for once his customary critical acumen fails to operate.

A volume of uterine physiology seems, on the face of it, to have a very specialized interest. Actually this book may be recommended to experimental biologists generally as well as to the specialist. The obstetrician and gynecologist, the endocrinologist, the pharmacologist, the general physiologist, the nutritionist, the pediatrician will all find data and discussion highly relevant to their specialties. The book has a breadth that invites the curious student and a presentation that should charm him. It is a most satisfying presentation of experimentalism in biological and medical science, and the scientific public is fortunate to have it.

GREGORY PINCUS

GENERAL PHYSIOLOGY

PRINCIPES DE PHYSIOLOGIE GÉNÉRALE. *Fourth Edition.*

By Henri Fredericq. Masson et Cie., Paris; H. Vaillant-Carmanne, S. A., Liège. 1,500 fr. 467 pp. 1949.

This is a peculiar sort of general physiology, much more reminiscent of those published 20 years ago than of recent books on the subject. The plan is the usual one of general physiology textbooks, but in spite of the fact that the author makes an excellent distinction between "special" (mammalian) and "general" physiology in his Introduction, the book deals very much with what is generally considered the field of mammalian physiology. More than one-third of the book is nerve and muscle physiology, and a great deal of time is spent with chronaxie and similar concepts of Lapique. The section on metabolism describes in detail the apparatus for studying total respiratory exchange in man and higher animals, but there appears to be no mention of microrespirometers or smaller, more modern equipment. All of the illustrations appear to be from the 19th century period in physiology. The foregoing strictures make it very difficult to recommend the book in any way as an introduction to the subject of general physiology.

L. J. MULLINS

BIOCHEMISTRY

PHENOMENA, ATOMS AND MOLECULES. *An Attempt to Interpret Phenomena in Terms of Mechanisms or Atomic and Molecular Interactions.*

By Irving Langmuir. Philosophical Library, New York. $10.00. xii + 436 pp. 1950.

It is very difficult to know what to say about such a book as this. It is primarily a collection of papers published by the author over a period of many years. The topics selected for inclusion in the book are as unrelated as Discussion of Science Legislation, Surface Chemistry, Atomic Hydrogen, and the like.

The papers on surface chemistry can be read with great profit by many biologists. Those on atomic hydrogen seem poorly chosen, as in reading them one finds a familiar paragraph or two which, upon glancing back to the preceding paper, one finds has been repeated verbatim. Aside from this redundancy, the story of atomic hydrogen is an entertaining one. Those papers which deal with political questions affecting science were written just after the end of World War II, and after the return of the author from attending the 220th anniversary of the Academy of Sciences of the U.S.S.R. They reflect the rosy optimism of that time concerning our relations with Russia.

L. J. MULLINS

PRINCIPLES AND PRACTICE IN ORGANIC CHEMISTRY.

By Howard J. Lucas and David Pressman. John Wiley & Sons, New York; Chapman & Hall, London. $6.00. xii + 557 pp. + 1 chart; text ill. 1949.

The authors have produced an excellent laboratory textbook which goes beyond many in the elementary field with respect to the wealth of descriptive material presented, as well as to the utilization of those physical chemical principles that are as basic to the "practice" of organic chemistry as they are to other subdivisions of chemistry. The approach is rational. This is no "cook-book." The reviewer is especially pleased to note the care that has been taken, in appropriate sections, to warn the student of certain hazards in the organic laboratory.

LESLIE HELLERMAN

ADVANCED ORGANIC CHEMISTRY. *Second Edition.*

By G. W. Wheland. John Wiley & Sons, New York; Chapman & Hall, London. $8.00. xii + 799 pp. 1949.

This excellent, advanced textbook is intended for students who have had antecedent courses in elementary organic chemistry and in elementary physical chemistry. The book emphasizes principles, relationships, and structural theory, and does not attempt to deal descriptively with a series of highly specialized topics. Thus it does not overlap seriously the territory encompassed in such a treatise as the valuable 2-volume work, *Organic Chemistry*, edited by Gilman. It may be helpful to indicate the space utilized in presentation of the major topics: fundamental concepts (including the kinds of bonds, intermolecular forces, and the forces between

atoms and molecules), 36 pp.; addition compounds, 35 pp.; acids and bases, 13 pp.; isomerism, configuration, and stereochemistry (5 chapters), 280 pp.; steric hindrance, 22 pp.; resonance, 47 pp.; electrostatic effects, 17 pp.; molecular rearrangements, 29 pp.; tautomerism, 67 pp.; free radicals, 3 pp.

The author, a seasoned teacher and skilled expositor, presents his subject matter in critical fashion with obvious attention to precision of statement. He does not "talk down" to his audience. Some passages necessarily present a considerable intellectual challenge to the student, but the treatment occasionally borders on the verbose in the attempt to elucidate certain difficult subjects. In general, the author has done very well. The citation and correlation of evidence often is impressive; literature references are very well selected. The treatment is up-to-date. It is to be presumed that this "second edition" constitutes the successor of the earlier syllabi by Wheland that were used in connection with courses at the University of Chicago.

Obviously, many or most competent lecturers in "advanced" organic chemistry refrain from basing their subject matter or method upon any particular textbook. Yet teachers and students alike will be glad that this book is available. It will be of interest also to those in non-chemical science who have occasion to deal with the essence and fundamental theory of organic chemistry.

LESLIE HELLERMAN

PROGRESS IN BIOCHEMISTRY. *A Report on Biochemical Problems and on Biochemical Research since 1939.*

By Felix Haurowitz. Interscience Publishers, New York (S. Karger, Basel, Switzerland). $7.50. xii + 405 pp. 1950.

This is an English translation of *Fortschritte der Biochemie* (cf. *Q.R.B.*, 25: 107). The author states that approximately one-fifth of the book was rewritten in the course of the translation. The exact plan of chapter headings and sub-headings of the German edition has been followed, and the author has wisely limited the increase in the number of pages to 40.

L. J. MULLINS

AN INTRODUCTION TO PLANT BIOCHEMISTRY. *Second Edition.*

By Catherine Cassels Steele. G. Bell & Sons, London. 22s. 6d. viii + 346 pp.; ill. 1949.

To biochemically-minded plant physiologists, the appearance of a book bearing in its title the words Plant Biochemistry is an encouraging sign, for botanists have lagged in the application of biochemistry to plant problems. This volume, the most recent in its field, is the second edition of a work originally published in 1934 (cf. *Q.R.B.*, 10: 240), and differs from the first edition mainly in the chapters on respiration, nitrogen metabolism, enzymes, and photosynthesis.

The book is divided into 7 parts: Introduction; Alcohols, Fatty Acids, Fats and Oils; Aldehydes, Ketones, and Carbohydrates; Plant Acids; Proteins and Related Compounds; Cyclic Compounds; and Plant Metabolism. The first 6 parts are essentially catalogs of the kinds of chemicals found in plants, little attempt being made to discuss their biogenesis or to integrate them with the plant, either metabolically or physiologically. As reference catalogs, these chapters will be of some value to workers in the field, but beginning students will probably find them rather rich fare. The numerous details unfortunately tend to obscure the important generalizations which should flow from these chapters.

Part VII, on Plant Metabolism, includes much modern material not found in previous books on this subject. Once again, the facts are not sufficiently integrated to convey the feeling that the plant is a well-knit functioning unit rather than a confused tangle of individual biochemical threads. The chapter on the chemistry of plant growth is extremely sketchy and fails to discuss any of the exciting recent work on the metabolic role of auxin. Indeed, the author seems barely aware of the existence or importance of auxins, and refers only obliquely to the early experiments of "Wendt" and of Kögl. Auxins a and b are not mentioned at all, nor are any of the contributions of Thimann, Bonner, Skoog, Haagen-Smit, or numerous others. The bibliography is extremely abbreviated, no reference at all being made to individual research papers, and most of the books cited being by now rather out of date. For instance, the most recent reference cited on nucleic acids is that of Levene and Bass in 1931; no reference is made to Chibnall's book on the protein metabolism of plants nor to the books of Went and Thimann and of Boysen-Jensen on plant hormones.

There are some errors of fact. In one place, transamination is defined as the "action of ammonia on α-hydroxy and α-keto acids produced in respiration," although a correct discussion is given elsewhere. The author uses the words hexokinase and phosphorylase interchangeably; the structure of pyridoxine is incorrect; lateral bud inhibition and the movements of *Mimosa* are classed as tropisms, and isocitric acid is called the most oxidizable substrate in the Krebs cycle. Among errors of omission are failure to mention the role of the B vitamins as root growth factors, the floral hormone, CO_2 fixation in succulents, and the more recent tracer work in photosynthesis.

An attempt is made to supply short laboratory experiments for each of the classes of compounds discussed. Some of the suggested experiments are valuable, but many are of this type: "Heat succinic acid in a dry test-tube; suffocating fumes of the anhydride are evolved." No experiments are given for the section on plant metabolism.

Despite numerous shortcomings, this is a valuable reference work which represents a distinct advance over other books in the field. It is not, however, recommended as a textbook for a college course in plant biochemistry.

ARTHUR W. GALSTON

SELENIUM. *Its Geological Occurrence and Its Biological Effects in Relation to Botany, Chemistry, Agriculture, Nutrition, and Medicine.*

By Sam F. Trelease and Orville A. Beath. Published by the Authors, Department of Botany, Columbia University, New York. $5.50. x + 292 pp.; ill. 1949.

It has always seemed to me that the story of selenium toxicity is a wonderful example of how a practical problem or a chance field observation may, if suitably pursued, yield many new facts of fundamental importance to science. The investigations on selenium described here had their beginning in the deaths of numerous sheep and cattle in the grazing areas of the western United States. The discovery that selenium accumulation in various astragali eaten by the animals was responsible for those deaths makes an exciting story, many chapters of which have been contributed by Beath and his coworkers. From these pioneer studies has emerged much information bearing on the problems of sulfur metabolism, amino acid synthesis, accumulation of salts, and the mechanism of action of inhibitors.

This book seems a scholarly, accurate, and well-rounded treatment of a little known but highly interesting subject. The tables, graphs, and photographs are very helpful, and the extensive bibliography provides an excellent basis for further study. In fact, the only quarrel to pick with the book lies in the realm of typography, since the pages are so reminiscent of the *American Journal of Botany* that it is difficult to remember that this is not a periodical.

ARTHUR W. GALSTON

THE ALKALOIDS. *Chemistry and Physiology. Volume I.*

Edited by R. H. F. Manske and H. L. Holmes. Academic Press, New York. $10.00. viii + 525 pp. 1950.

This is the first of 5 projected volumes which are planned to serve as handbooks for the great volume of published work on the chemistry and pharmacology of the alkaloids. Supplements have been promised at periodic intervals in order to keep the material up to date. Volume I deals with the chemistry of the pyrrolidine, pyrrolizidine (*Senecio*), pyridine, tropane, and strychnos alkaloids. In addition there are chapters on sources of alkaloids and their isolation by the senior editor, and upon alkaloids in the plant by W. O. James of Oxford University. If the volume is to be criticized at all it would be for the somewhat surprising omission of significant contributions to alkaloid chemistry which appeared as much as 2 years prior to the date line of the book. Chief among these is the paper by Woodward, Brehm, and Nelson which appeared in 1947 and which set forth the now generally accepted structure for strychnine.

To the general biologist this series will perhaps prove superior to the single volume by Henry as a convenient source of data regarding physical properties of individual alkaloids. The extensive tables of the chapters on the strychnos and the tropane alkaloids are unique in this respect. Data on biological occurrence are much less complete than in Henry's volume. By far the outstanding feature of the book from the biological point of view, however, is the thoroughgoing and ably written chapter by James on alkaloids in the plant. This chapter presents an excellent discussion of the histological distribution, ontogenetic accumulation, translocation, biosynthesis, and metabolic relationships of the alkaloids as they occur in the plant body. Some of these subjects have not previously been well summarized in the literature. The section on nutrition represents the interesting outcome of experiments conducted largely in England upon the effects of fertilizers on alkaloid production in *Hyoscyamus* and *Atropa*. It is unfortunate that the extensive and thorough investigations of the Dutch in Java upon quinine production in the cinchona tree were apparently not available to the author. This work, amounting to over 20 years of methodical experimentation, was excellently summarized by M. J. J. M. Kerbosch in his retiring address before the 11th Annual Congress of the Soekaboemie and Rubber Planters' Society in Bandoeng, June, 1937. Although James is manifestly unable to come to a positive conclusion concerning either the mechanism of synthesis or the metabolic significance of a single alkaloid, it is evident that experimental data such as he has so ably summarized in this chapter represent the indispensable foundation for the ultimate solution of these problems. Perhaps future supplements of this potentially valuable series will record the answers.

R. F. DAWSON

THE PLANT ALKALOIDS. *Fourth Edition.*

By Thomas Anderson Henry. Blakiston Co., Philadelphia and Toronto. $14.00. xxiv + 804 pp. 1949.

Although written for the chemist interested in proofs of chemical structure, this book possesses several features of value to the biologist. Of these the most outstanding is the general cataloguing of known alkaloids with the plants from which they are obtained. In this connection, the concluding chapters of the book are of especial interest, since they list alkaloids of infrequent occur-

rence, unknown structure, or uncertain existence. The book is thus a mine of helpful suggestions for students in search of new chemical and biochemical problems.

For those interested in problems of comparative biochemistry and evolution, the volume is particularly helpful as a source of correlative data which would otherwise have to be assembled from a vast and relatively uncoordinated literature. A spot characterization, for instance, of the alkaloids of the principal orders of the angiosperms can be made with the aid of this volume, with the surprising outcome that those orders which are more primitive (e.g., the Ranales and Geraniales) appear to possess the greatest numbers of alkaloidal groups (e.g., pyridine, quinoline, etc.). More advanced orders contain progressively fewer of these groups represented among their constituent alkaloids, and the question thus arises whether the faculty for alkaloid production is an evolutionarily primitive characteristic within the angiosperms.

A second valuable feature of the book is the inclusion of data on physical properties and derivatives. Few biologists escape the necessity for consulting handbooks and original articles accessible to them only with difficulty, for information regarding stabilities, salts, derivatives, and criteria for purity and identity of alkaloids and other natural products. While Henry's book does not presume to be a handbook of chemical and physical constants, many such data are included.

Lastly, the reviewer wishes to commend to the general biologist the Introduction to this book. There are few more stimulating and artless essays upon a subject of such importance to biology and chemistry. Indeed, the book as a whole is a work of exceptional scholarship and merit and should find a place upon the shelves of every serious student of natural products and of plant and animal metabolism.

R. F. DAWSON

SOILS: THEIR PHYSICS AND CHEMISTRY.

By A. N. Puri; foreword by Firman E. Bear. Reinhold Publishing Corp., New York. $7.00. xviii + 550 pp. 1949.

According to the author's preface, this large work is "written primarily for students of agriculture . . . indeed . . . for beginners, and is not intended to be a treatise." Yet it contains 118 tables of detailed experimental results and 61 figures, all drawn from the author's researches. At the outset, therefore, even the most cursory examination reveals the enormous gap between the author's bland statement of purpose and the true scope of the work. It is not a textbook at all, but a slightly simplified compilation of research papers, grouped under 3 main headings: Chemistry of the Soil; Mechanical Analysis of Soils; and Soil Moisture.

The author's attitude in relation both to subject matter and to his readers is simple. His own generalizations are to be given the force of authority, but as regards the work of others "theories have been left in the background, for theories confuse the novice and tax even the initiated." It is hardly surprising, therefore, that a person who starts from such a vantage point should produce a work characterized by a complete lack of balance, and notably out of date in its main thesis. That these criticisms are not out of place may readily be seen by a perusal of the first 3 paragraphs of the first chapter. Here it is evident that the author has absolutely no concept of geological or mineralogical factors as they influence soil formation and development. He regards them as completely subordinate to his main thesis, which is that all soil colloids are sufficiently alike to be lumped together without distinction. He carries this so far as to calculate specific surface and even pore size distribution from the mechanical analyses. I have never seen a better example of the dangers of pursuing a half truth to its logical conclusions.

On the credit side: the specialist will find here many experimental methods and results of interest to him. He will need to exercise considerable caution, because the results are always interpreted in the light of the author's general thesis. However, the methods show considerable ingenuity, and it is here that the main value of the book may be found, since many of the original papers were published in somewhat inaccessible journals.

C. EDMUND MARSHALL

THE CHEMISTRY OF ORGANIC MEDICINAL PRODUCTS. *Third Edition.*

By Glenn L. Jenkins and Walter H. Hartung. John Wiley & Sons, New York; Chapman & Hall, London. $7.50. x + 745 pp. 1949.

According to the authors' preface, this volume has been written as a textbook for students who have had basic courses in chemistry and are interested in the chemistry of medicinal and related products. Their prime objective was to organize the large number of organic medicinal compounds according to the accepted scheme of chemical classification. Typical methods of synthesis of important drugs have been described.

The authors have succeeded in presenting an exceedingly useful and valuable text, especially for advanced courses in medicinal chemistry, for pharmacologists, organic medicinal chemists, and workers in the fields of chemotherapy, biological and pharmaceutical chemistry. The first and second editions were enthusiastically received by teachers, students, and practitioners in these fields. The third edition, embodying new sections on the antibiotics, antimalarials, sulfonamides, amino acids, antihistaminics and enzymes, will be found to be even more useful.

The classification of the text is according to chemical

composition of drugs. Thus, salicylic acid, ascorbic acid, etc., are found in Chapter VI, the Carboxyl Group; and such drugs as acetylcholine and epinephrine in Chapter VIII, the Amines and Amine Derivatives. A 40-page index makes it possible to find quickly an individual compound, however. The association of medicinal agents of similar chemical structure is provocative to ideas for the synthesis of new compounds.

A useful feature of the text is the list of references at the end of each chapter and a general bibliography according to subjects at the end of the volume. These serve as a guide to the literature for theoretical concepts of drug action, therapeutic uses of drugs, and subject matter not strictly pertinent to the objectives of the book.

As one who has used this text since its first edition, this reviewer can recommend it without reservation as a useful teaching and laboratory aid.

C. JELLEFF CARR

BIOLOGICAL APPLICATIONS OF TRACER ELEMENTS. *Cold Spring Harbor Symposia on Quantitative Biology. Volume XIII.*

The Biological Laboratory, Cold Spring Harbor, Long Island, New York. $7.00. xii + 222 pp. + 4 plates; text ill. 1948.

This volume consists of 25 technical papers, 24 of which made up the symposia held during the second week of June, 1948. Space will permit only a listing of the topics and their respective authors, together with very brief descriptions of the main contents of the articles.

Arnason, "Chromosome breakage induced by absorbed radioactive phosphorus,"—effect of absorbed P^{32} on producing mutation. Benson and Calvin, "The path of carbon in photosynthesis, "—the intermediates carbon passes through during photosynthesis. Bentley, "The use of the O^{18} isotope,"—brief review of some work with this isotope. Bergstrand, Eliasson, Hammersten, Norberg, Reichard, and von Ubisch, "Experiments with N^{15} on purines from nuclei and cytoplasm of normal and regenerating liver,"—on the administration of isotopic glycine (N^{15}) to rats during the early stage of liver regeneration. Bernhard, "Formation of lipids by the microorganism *Phycomyces Blakesleeanus*,"—aldo-condensation and fat formation in plants. Block, "The biological synthesis of lipids," —the relative contributions of acetate and pyruvate carbon in fat synthesis in animal tissue. Branson, "The use of isotopes in an integral equation description of metabolizing systems,"—isotopes in rate determination of biochemical reactions. Brown, "Studies of purine metabolism,"—the *in vivo* synthesis and degradation of purines. Brues and Buchanan, "Studies of the over-all CO_2 metabolism of tissue and total organisms,"—some factors affecting the retention of C^{14} after inhalation of C^{14} O_2. Burch, Threefoot, Cronvich, and Reaser, "Theoretic and experimental considerations of biologic decay periods: Studies in man with the use of Na^{22},"—turnover of sodium in patients with congestive heart failure. Carson, "Design and interpretation of carbon isotope experiments in bacterial metabolism,"—the advantages in the use of microorganisms for studying fundamental types of biochemical reactions. Ehrensvard[1] "Amino acid metabolism in *Torulopsis utilis*,"—CO_2 fixation and labeled glycine and alanine uptake by *Torulopsis* yeast. Flexner, Cowie, and Vosburgh, "Studies on capillary permeability with tracer substances,"—rates of turnover of plasma H_2O, sodium, chloride and ferric beta$_1$ globulinate. Gemmill, "Isotopes in pharmacodynamics,"—short review of the subject. Giles and Bolomey, "Cytogenetical effects of internal radiations from radioisotopes,"—effects of radioisotopes taken up in solution in producing chromosomal rearrangements in the microspore nuclei of the spiderwort. Greenberg, Friedberg, Schulman, and Winnick, "Studies on the mechanism of protein synthesis with radioactive carbon-labeled compounds,"—on process of amino acid incorporation into liver protein; fate during growth and regeneration and the hormonal control of protein synthesis. Gurin and Crandall, "The biological oxidation of fatty acids,"—a review on mechanisms whereby fatty acids are converted to two-carbon units, the nature of these intermediates and the probable reactions involved for their complete oxidation. Hevesy, "Historical sketch of the biological application of tracer elements,"—a general survey. Kamen and Spiegelman, "Studies on the phosphate metabolism of some unicellular organisms,"—the uptake and turnover of phosphate by heterotrophic (yeast), autotrophic (algae), and photoorganotrophic (*Rhodospirillum rubrum*) organisms. Norris and Kisieleski, "Comparative metabolism of radium, strontium and calcium,"—the retention of these minerals by rats of comparable ages and weights. Rittenberg, "The application of the isotope technique to the study of the metabolism of glycine,"—the fate of the carbon chain of glycine labelled with N^{15}. Sacks, "Mechanism of phosphate transfer across cell membranes,"—on the formation of an organic phosphate compound on the cell membrane capable of penetrating the membrane. Shemin, "The biosynthesis of porphyrins,"—a review of the evidence for the utilization of glycine for porphyrin synthesis. Using, "The use of tracers in the study of active ion transport across animal membranes,"—on the limitation of the tracer method in transport and permeability studies. Wood, "The synthesis of liver glycogen in the rat as an indicator of intermediary metabolism,"—on the distribution of carbon isotopes in glycogen after feeding labeled compounds.

DAVID B. TYLER

MICROBIOLOGY

FUNDAMENTALS OF BACTERIOLOGY. *Fourth Edition.* *By Martin Frobisher. W. B. Saunders Co., Philadelphia and London.* $5.50. xxii + 936 pp. + 3 charts; text ill. 1949.

The fourth edition (3rd ed., *Q.R.B.*, 20: 184) of this excellent textbook is intended for beginners "with a moderate knowledge of elementary biology, physics, and chemistry." Perhaps it might better have been called "Fundamentals of Microbiology," since microorganisms other than bacteria are given comprehensive treatment. Emphasis is laid upon general principles, although special topics such as soil, food, and air microbiology are excellently handled. The final section gives an overall treatment of some pathogenic microorganisms. For a beginning textbook, this one contains a surprising amount of detailed, accurate, and up-to-date information. Fairly recent topics such as antibiotics receive sound treatment. In particular, the treatment of aspects of chemistry and physics of importance in microbiology is very well done. There is an abundance of good illustrations, with a considerable elimination of ancient and outdated material. Each chapter is followed by a number of well-selected references, bringing many of the topics down to the year 1949. Despite a careful search, no obvious errors of fact or interpretation were spotted. The book can be highly recommended.

WALTER C. TOBIE

ELEMENTARY EXPERIMENTS IN DAIRY BACTERIOLOGY. *By Raymond N. Doetsch and Marvin L. Speck. Burgess Publishing Co., Minneapolis.* $1.75 (paper). iv + 62 pp.; ill. 1949.

This laboratory manual contains 23 exercises for a 1-semester course for students of bacteriology, dairy technology, dairy husbandry, and food technology who have had at least a year of general bacteriology and of general chemistry.

It has been very satisfactorily reproduced from typed sheets by the mimeoprint process. The paper takes both ink and pencil well, permitting the student to record his experimental results and sketches in the appropriate places adjacent to the text.

Those interested in giving a laboratory course of this sort will find that the manual merits careful examination.

WALTER C. TOBIE

LABORATORY MANUAL FOR FOOD MICROBIOLOGY. *By W. C. Frazier and E. M. Foster. Burgess Publishing Co., Minneapolis.* $2.00 (paper). vi + 77 pp.; ill. 1949.

This excellent laboratory manual contains 48 experiments in what appears to be a moderately advanced course in food microbiology. The relatively large number of experiments permits the instructor to choose some three dozen to be done during a one-semester course. The manual is very well reproduced from typing, using the mimeoprint process. Apparently the student is to enter his results in another notebook, although the left-hand page of the manual is left blank. Each exercise is followed by a number of questions to be answered, as well as several references for further reading. Various institutions differ in their approach to laboratory exercises, but those seeking a sound laboratory manual for food technology will quite possibly find their requirements well met by this one.

WALTER C. TOBIE

INDUSTRIAL MICROBIOLOGY. *Second Edition.* *By Samuel Cate Prescott and Cecil Gordon Dunn. McGraw-Hill Book Co., New York, Toronto, and London.* $8.50. xii. + 923 pp. + 3 charts; text ill. 1949.

A review of the second edition of any book should satisfy two groups of readers, those who are familiar with the first edition and wish to learn about changes and additions, and those to whom the book is new.

This volume is a treatment of the industrial applications of microbiology, and therefore presumes a fairly comprehensive knowledge of general bacteriology. That is a logical way to treat any applied science; a mixture of science and application would result in a bulky volume which could not offer enough science to the beginner, and would be uninteresting to those readers who want only the applications. On this point, the authors have not been consistent. The chapter describing the yeasts (49 pp.) gives considerable detail about their morphology, genetics, and nutrition. The general chapter describing the molds (19 pp.), gives less space to a much more diversified group and must be quite unsatisfactory to anyone not familiar with this group. The general chapter on the bacteria consists of only 3 pages, summarizing in tabulated form their usefulness in various industries without any information about their properties or modes of life. The book is definitely meant only for readers familiar with general bacteriology. The subject matter is divided into three main parts, according to the types of organisms concerned, namely, the Yeast Industries (308 pp.), the Bacterial Fermentations (244 pp.), and the Mold Industries (155 pp.). This is followed by 3 additional chapters for various types of microorganisms which do not fit into the above subdivisions, namely, the Antibiotics, and the Microbiology of Wood and of Textiles.

The section on the Yeast Industries, covers not only the manufacture of alcohol for beer, wine, distilled liquors, and industrial alcohol, but also treats quite

extensively the manufacture of yeast for human consumption and as animal feed. The chapter on Yeast Manufacture has grown from 11 to 59 pp. Its importance lies in the production of the readily digestible yeast proteins from ammonia and molasses, or starch, or chemically treated cellulose, at a very rapid rate, not to be equalled by the rate of growth of any plant or animal now used as a source of protein.

The Bacterial Industries begin with the fermentations of starch or sugar by several clostridia or bacteria of the *B. macerans* group, resulting in acetone, butanol, ethanol and isopropyl alcohol. Then follow the acetic and lactic fermentations, the latter including the manufacture of sauerkraut and pickles, and of cheese. This leads to propionic fermentation. A large chapter is devoted to the manufacture of 2,3-butanediol by four different types of bacteria, followed by a shorter discussion of enzyme and riboflavin production by bacteria. Silage, leather manufacture, and the curing of tobacco are briefly mentioned.

The chapters on Mold Fermentations emphasize citric and gluconic acid formation, but mention many other commercial uses. The preparation of mold enzymes has become important: amylase, invertase, pectinase, and protease can be produced. Fat synthesis by molds has received considerable attention.

The chapter on Antibiotics mentions 27 products by bacteria, 19 by actinomycetes, and 32 by molds. The manufacture of penicillin and of streptomycin is described in great detail, well illustrated. Textile Microbiology includes the deterioration of cotton and wool, as well as the manufacture of the fibers of flax and hemp by retting. Microbiology of Wood includes destruction as well as discoloration of wood. A brief treatment of wood-destroying insects is added.

The two appendices are probably too short to satisfy the needs of the industrial microbiologist. Appendix A (10 pp.) treats in small print the problems of detergency, disinfection, and sterilization. Only chemical sterilization is mentioned; no physical methods are given. Appendix B (6 pp.) discusses Treatment and Disposal of Industrial Microbiological Wastes. This is inadequate. Aside from these appendices, the subject matter is covered well and presented clearly. Many chapters have flow sheets, tables showing the wide uses made of the various products of microbial activity, or photographs directly from industry illustrating the type of equipment used. The book is a clear and informative presentation of the industrial applications of microbiology for the person who knows general bacteriology.

OTTO RAHN

THE MICROBIOLOGY OF SUGARS, SYRUPS AND MOLASSES. *A Reference Book for the Raw Sugar Manufacturer or Refiner and for All Industries Engaged in the Manufacture, Storage or Commercial Utilization of Sugars, Syrups and Molasses.*

By William L. Owen. Barr-Owen Research Enterprises, Baton Rouge, La. (Printed by Burgess Publishing Co., Minneapolis.) $5.00. iv + 275 pp. 1949.

The book is lithoprinted from a typewritten manuscript, but is clearly legible. It is meant, as the subtitle says, primarily for sugar manufacturers and for the industries using sugars, syrups, and molasses; a general knowledge of the methods of sugar manufacture is taken for granted.

The text follows essentially the process of manufacture, starting with the microbial flora of the fresh juice from sugar cane or sugar beets, and discussing the fate of the various microorganisms throughout the manufacture of sugar, the flora of syrup, of raw sugar, and finally the deterioration of molasses. Separate chapters, each with its own bibliography, are devoted to these various stages of manufacturing. The bibliography includes many old references, an indication that the author has tried to provide a historical review.

The freshly pressed juice which has a high bacterial count (about 200,000 per ml.) can be purified by filtration through diatomaceous earth or charcoal. This process removes 75 to 99% of the microorganisms. The use of chlorine in the cane sugar mill seems indicated. The juices ferment rapidly if allowed to stand, and therefore sugar is extracted at temperatures considerably above 60°C. The methods for counting and identifying the bacteria are given in great detail.

The juice is classified further by liming, heating, adding acid phosphates, adding SO_2, and finally, after filtering or settling by concentration in a vacuum. A special chapter is devoted to the persistence of thermophilic bacteria which cause so much trouble in vegetable canning. The microbiology of syrups, with occasional reference to maple syrup, is treated in the same semi-professional way. The various types of decomposition and the difficulty of canning, because of the protection of microorganisms by the high concentration, are discussed, and the types of spoilage are described.

The microbiology of raw sugar connects the inversion and loss of "sucrose value" in storage of the usually moist sugars with the bacterial and mold flora, which may amount to several thousand or even several hundred thousand per gram. By contrast, the flora of the dry refined sugar rarely exceeds 100 microbes per g. Only the thermophilic sporeformers may be higher in numbers, but upon the insistence of the canning industry, it has been made possible to manufacture refined sugar practically free from thermophilic sporeformers. The deterioration of black-strap molasses, though sometimes quite rapid as a frothy "fermentation," is a purely chemical reaction not connected with microorganisms.

The book has a very detailed subject and author in-

dex. Parts of it are difficult to read because it is meant for sugar technologists, and the reader may not be familiar with the details of sugar manufacture.

OTTO RAHN

PRINCIPLES OF MICROPALAEONTOLOGY. *2nd Edition. By Martin F. Glaessner. John Wiley & Sons, New York.* $6.00. xvi + 296 pp. + 14 plates + 5 charts; text ill. 1948.

Three sections of this volume cover, respectively, a general discussion of micropaleontology, the Foraminifera, and stratigraphic micropaleontology. The first section contains a historical summary of the field of micropaleontology, a general discussion of various types of microfossils, and the methods used in micropaleontology. Radiolaria, calpionellids, ostracods, coccoliths, silicoflagellates, dinoflagellates, diatoms, bacteria, sponge and alcyonarian spicules, echinoderm fragments, conodonts and scolecodonts, as well as other forms of uncertain affinities, are all discussed briefly and typical examples are illustrated. This general, although brief, discussion of all phases of micropaleontology is very useful, particularly since the majority of books on micropaleontology are restricted entirely to discussions of the Foraminifera alone. The collection and preparation of microfossils is discussed, with a useful summary of the methods followed by various authorities and laboratories in the disintegration, thin-sectioning, sieving, flotation and picking of samples, the staining, coating and etching of specimens, and the types of slides used for mounting the specimens. Illustrations show the various types of apparatus.

The second part comprises about one-half the bulk of the volume, and discusses the Foraminifera in some detail. It has a more complete discussion of recent work on the life cycle of the Foraminifera than other current texts, and also covers wall composition, morphology, chamber arrangement, etc. A somewhat theoretical discussion of the basis for separation into species, genera, and higher taxonomic groups is included with the classification. A summary of earlier classifications and their bases for subdivision precedes the classification developed by Glaessner, which contains seven superfamilies, grouping related previously described families. Portions of this section are quite detailed but unfortunately many usually recognized genera are not mentioned, and there is thus no way of determining where these would fall in his classification, or if Glaessner did not recognize them as valid genera. No synonomy is given and genotypes are cited for only a few of the genera, usually only for the type genus of the families. Although a large number of figures are given, not all of the genera discussed are illustrated. For these reasons, this section of the book is not as useful for a working manual for taxonomic students as are those of Cushman and Galloway. It would probably suffice for introductory classes, however. A summary of the present status of knowledge of the paleoecology of the Foraminifera completes this section of the book.

The final portion concerns the stratigraphic sequence of microfaunas, and will be very useful to students, although it must be realized that the character of a given microfauna may be quite different from that described as "typical" of a geologic age, because of the local effect of environment. Glaessner also discusses stratigraphic correlations based on microfossil evidence, and the application of micropaleontology to petroleum geology.

An appendix gives a synopsis of Glaessner's classification, with superfamilies, families and subfamilies listed. Typical genera and their geologic ranges are mentioned. A bibliography gives additional references for the topics discussed in the book, and those on microfossils other than Foraminifera should prove especially helpful to students desiring a broader background in micropaleontology.

A. R. LOEBLICH, JR.

EXPERIMENTS IN SOIL BACTERIOLOGY. *By O. N. Allen. Burgess Publishing Co., Minneapolis.* $2.50 (paper). x + 126 pp. 1949.

This manual contains 40 exercises for a one semester course with 2 two-hour laboratory periods per week for seniors and graduate students. It is mimeoprinted, with a spiral-type binder. Like many other works bearing the name "bacteriology" in the title, it is really more of a manual of microbiology in the wider sense. Besides bacteria, laboratory exercises are given on algae, protozoa, and fungi. The biochemical activities of the soil organisms are heavily stressed with attention to nitrification, nitrogen fixation, digestion of cellulose, and the activities of the sulfur and iron bacteria. Accordingly, chemical facilities outside those of the usual microbiology laboratory must be available if all the exercises are to be done. The manual can be highly recommended to the attention of those interested in laboratory work in soil microbiology. It will undoubtedly be used by other institutions besides the University of Wisconsin where it was compiled.

WALTER C. TOBIE

HEALTH AND DISEASE

STUDIES IN PSYCHOSOMATIC MEDICINE. *An Approach to the Cause and Treatment of Vegetative Disturbances. By Franz Alexander and Thomas Morton French, with Catherine L. Bacon, Clarence Bernstein, Ludolf N. Bollmeier, Margaret W. Gerard, Roy R. Grinker,*

Martin Grotjahn, Adelaide M. Johnson, Harry B. Levey, Maurice Levine, Helen V. McLean, William C. Menninger, Albrecht Meyer, Milton L. Miller, Sidney A. Portis, Leon J. Saul, Louis B. Shapiro, Carel Van der Heide, and George W. Wilson. Ronald Press Co., New York. $7.50. xiv + 568 pp.; ill. 1948.

This is a collection of 34 papers, by 20 authors, which first appeared in various psychiatric journals between 1934 and 1947. Franz Alexander has written an introduction outlining the principles of psychosomatic medicine developed by the Chicago school of psychoanalysis. The contributing authors have adhered closely to these principles in their papers, thus making for clarity and continuity of presentation and interpretation throughout the book. The papers are sorted into eight large topical categories: General Principles, Disturbances of the Gastrointestinal Tract, Disturbances of the Respiratory System, Cardiovascular Disturbances, Endocrinology and Metabolism, Skin Diseases, Joints and Skeletal Muscles, and Miscellaneous Studies.

There is growing evidence that the psychosomatic approach is being considered the beginning of a "new era in medicine." Those who are interested—practitioners and laymen alike—in "an orientation which attempts to understand diseases not as isolated processes but as disturbances of the total coordination of organic processes" will find the book profitably informative. The inclusion in the psychosomatic approach here of the "participation of the total personality in the disease process" will have particular appeal for the hardy perennial students of human behavior.

JOSEPH C. FRANKLIN

MOBILIZATION OF THE HUMAN BODY. *Newer Concepts in Body Mechanics.*

By Harvey E. Billig, Jr., and Evelyn Loewendahl. Stanford University Press, Stanford; Geoffrey Cumberlege, Oxford University Press, London. $2.00. xii + 65 pp.; ill. 1949.

This book consists of 40 pages of printed subject matter and 22 full pages of illustrations, most of which are photographs. Except for 2 illustrations of faulty posture, each illustration shows a passive manipulation or an active stretching movement as follows: rotation and lateral flexion of the neck, rotation of the dorsal spine, flexion of the spine; and, in various combinations, flexion, adduction, extension, and abduction of the hip with the knee extended. The printed matter consists of the following: 2 pages discussing posture and mobility, a brief and unconvincing discussion about the role of shortened ligaments in relation to posture and mobility; a brief description of the tests used to determine the location of the ligamentous tightness. A short chapter describes the technique for each "mobilization" illustrated, and along with each description there is a sentence or paragraph commenting on the conditions relieved by such manipulative treatment. There is a short chapter describing the rhythm exercises designed to increase the kinesthetic or proprioceptive sense. The last chapter is the only well-written one in this book. It discusses, briefly, the neuro-muscular mechanisms in the development of power, endurance, relaxation, and well-coordinated motor patterns. It touches on the subject of muscle imbalance and the rational approach to treatment in the care of weak and paralyzed muscles.

The authors of this book contend that shortened ligaments are largely responsible for stiffness and immobility of the body. They state that "by the process of lengthening the ligaments, a double purpose is accomplished: (a) the correction of bad alignment is made possible and (b) the compression on peripheral nerves, causing pain sensation, is eliminated." The following excerpt from the book denotes the nature of the claims made with regard to the therapeutic value of the described procedures. "Mobilization 1 (active). Forced rotation in the upper cervical spine region. Complaint of basal headaches, occipital headaches, pain and sensitivity up over the scalp, frontal and temporal headaches, deep aching in the eye, and transient blurring of vision may thus be relieved. The symptoms of blurring of vision have to do with dilation and contraction of the pupils resulting from autonomic nerve irritation stimulae involving the cervical ganglia." Active and passive stretching movements have a definite place in the treatment of painful conditions associated with faulty body mechanics. But the analysis of the problems involved in body mechanics, as presented in this book, is so inadequate, the therapy prescribed is such a small part of the overall problem of treatment, and the claims of the therapeutic value of the procedures appear so exaggerated that the book cannot be recommended.

HENRY O. KENDALL

DENTAL ANATOMY: (*I*) *The Form and Function of the Permanent Teeth;* (*II*) *The Form and Function of the Deciduous Teeth.*

By Robert C. Zeiss (I) and James Nicholls (II). C. V. Mosby Co., St. Louis. $14.00. xvi + 486 pp.; ill. 1949.

This book is concerned with the morphology of the human teeth, dental anatomy, the science of form, and structure of the human teeth. It is a magnificent treatment of each of the 32 permanent and 20 deciduous teeth as a separate and distinct organ of the body. Ten figures are devoted to each of the 52 teeth to show its minute characteristics and peculiarities, and each is carefully and systematically described in the text. Additional figures are included in the introduction and

in describing the internal makeup of the teeth. The glossary and index have been carefully prepared. This is a beautiful book in a specialized field.

JOHN A. CAMERON

BONE MARROW BIOPSY. *Haematology in the Light of Sternal Puncture.*

By S. J. Leitner; English translation revised and edited by C. J. C. Britton and E. Neumark. Grune & Stratton, New York. $8.50. xii + 433 pp. + 7 plates; text ill. 1949.

The morphology of blood and bone marrow occupies a position of importance in both clinical and basic medical science. The field is not new, but significant advances have been made in recent years. The derivation of blood cells from bone marrow was recognized in 1868 by Neumann. In 1891 Ehrlich discovered that blood cells could be stained differentially by specific dyes. This stimulated the study of peripheral blood, which developed far in advance of comparable studies of human bone marrow. Bone marrow biopsy by trephining was introduced in 1905 by Pianese, but was too radical for general use. The simpler sternal puncture, introduced by Arinkin in 1929, was a more practical technique. It provided a source of fresh human tissue with obvious advantages over autopsy material and animal tissue. In the intervening years the lag in our knowledge of human bone marrow has been largely overcome. The relationship of this important organ (the largest in the body) to peripheral blood can now be described with greater certainty than ever before. It is therefore interesting to receive a publication dealing with the present status of this field. The volume under consideration originated in a Swiss laboratory and was translated and rewritten by a hematologist and a pathologist in England.

The conception of cell relationships and derivations held by the authors, upon which interpretations are necessarily based, is presented in the Table of Origin of Cells (facing p. 48). The unitarian theory is favored. The common stem cell is designated a marrow reticulum cell. The granulocytic series is derived from myeloblasts, the earliest recognizable precursors of granulocytes, and the intermediate stages do not differ from those in general acceptance. The erythrocytic series, first recognizable in the proerythroblasts, gives rise to all normal and abnormal erythrocytes except megalocytes. The latter can be traced back through a series of forms to promegaloblasts, comparable in immaturity to proerythroblasts. The megakaryocytic series (eventually forming platelets) is also independent, being first recognizable in the megakaryoblasts, a cell type which has differentiated from marrow reticulum cells. Monocytes, the mature forms of which are illustrated with a strongly curved and secondarily indented nucleus, are derived in a separate series from the marrow reticulum cell, but are conceded to be largely of extramedullary (lymphoid) origin. The most radical departure from current concepts concerns the plasma cells. They are represented as differentiating in an independent series that includes plasmoblasts and proplasmocytes. The former develop from marrow reticulum cells, and the series is morphologically distinct at a stage comparable to other blastic forms.

Other chapters on normal anatomy describe cell counts, maturation curves, and mitoses. Although careful studies have been made, there is much to be learned about these significant characteristics. The greater part of the book deals with the clinical pictures found in the blood and bone marrow in well recognized hematological diseases. There are chapters on subjects of related interest such as the effects of irradiation, demonstration of pathogens, defense reactions, tissue culture of marrow, etc.

The author's tendency toward informal use of terms in the text, although admittedly difficult to avoid, detracts from the clarity of the discussions. Some background must be called on to understand variations of the terms found in the Table of Origin. There are copious and highly useful references to literature throughout the text, an extensive bibliography closing each chapter. The photographic illustrations in black and white leave much to be desired. Many of them are not clear enough to illustrate the structural details which are paramount in importance in this field. The color plates are clearer, showing good distinction between different hues.

This book presents the opinions, matured by new and improved techniques, of experienced workers in a significant field. Those interested in the problems of hematology should find it useful.

F. N. LOW

AN OUTLINE OF NEUROPATHOLOGY. *Second Edition.*

By A. B. Baker. Wm. C. Brown Co., Dubuque, Iowa. $3.50 (paper). iv + 172 pp.; ill. 1949.

In this outline of neuropathology consideration is given to the following subjects: Intracranial Neoplasms, Diseases of the Intracranial Vessels, Brain Trauma, Meningitis, Encephalitis, Extrapyramidal Motor System Diseases, Demyelinating-Sclerosing Diseases, Pathology of the Spinal Cord, Neurosyphilis, Pathology of the Peripheral Nerves, So-called Functional Mental Disorders, and Feeblemindedness. It contains an adequate index and bibliography, and the photographic illustrations, for the most part, are original and well made. It is suggested that future editions be provided with a hard cover.

DAVID B. TYLER

1949 YEAR BOOK OF PATHOLOGY AND CLINICAL PATHOLOGY.

Edited by Howard T. Karsner and Arthur H. Sanford. Year Book Publishers, Chicago. $4.75. 543 pp.; ill. 1950.

The 1949 contributions to pathology are reviewed by Karsner, whose editorial comments and notes are helpful for evaluating the importance of the material at hand. There are also 4 special articles of interest to pathologists: Pathology of Atomic Bomb Casualties (Lebow, Warren and DeCoursey); Problem of Early Cancer (Gall); The Physiopathology of Cancer (Homburger); and Neoplasia in Fishes, Amphibians and Reptiles (Lucke and Schlumberger).

The survey of the 1949 contributions to clinical pathology has been made by Sanford. This survey covers hematology, clinical chemistry, liver function tests, serology, bacteriology and mycology, endocrinology, and microscopy. Of special interest is the review of articles on cytology. This is emphasized by Sanford, who notes that the cytologic diagnosis of malignancy claimed considerable attention during 1949.

ELLA H. OPPENHEIMER

THE COMMON INFECTIOUS DISEASES. *A Handbook for Students and Postgraduates.*

By H. Stanley Banks. Williams & Wilkins Co., Baltimore. $4.50. viii + 354 pp.; ill. 1949.

The diseases covered by this book are diphtheria, scarlet fever, hemolytic streptococcal sore throat, erysipelas, erysipeloid, measles, rubella and associated congenital malformations, whooping cough, mumps, glandular fever, influenza, chickenpox, vaccinia, smallpox, meningococcal fever, poliomyelitis, typhoid and paratyphoid fevers, acute diarrhea in infants, and infective gastro-enteritis of infants, as taught by the author to students at various hospitals in London. A very competent and worthwhile piece of work seems to have been accomplished. Whether the treatment is more illuminating than that given in corresponding American works is a question for users to decide. At any rate, the book should be of value as a presentation of a British point of view. One regrettable error was the fact that the cover bore the title *The Common Infectious Disease* (*not* Diseases). This led to a moment of confusion as to whether the book was a monograph on the common cold, or possibly dealt with some other prevalent disease!

WALTER C. TOBIE

OBESITY. *American Lecture Series. A Monograph in American Lectures in Endocrinology. Publication Number 36.*

By Edward H. Rynearson and Clifford F. Gastineau. Charles C. Thomas, Springfield, Ill. $3.50. viii + 134 pp. + 1 chart; ill. 1949.

This is an excellent monograph dealing with the most frequent physical abnormality found in the general population. The available evidence demonstrates the adverse influence of obesity on hypertension, heart disease, atherosclerosis, diabetes, cirrhosis, cancer, pulmonary emphysema—in fact, practically the entire gamut of ills that beset the human race. Since about 30 per cent of the general population are overweight by 10 per cent or more, and since statistical studies show that such overweight individuals have little chance of attaining optimal life expectancy, obesity can be considered a medical problem of the first order.

The notion that fat people stay fat regardless of what they eat is nonsense. It is usually the lame excuse of those of us who sometimes seek to make respectable our gluttonous appetites or to conceal them. "Fat comes only from food, and obesity results from eating more than is required to meet the energy requirements of the body." Actually, fat people must eat more than normal in order to remain fat. The mechanisms that determine appetite and satiation, therefore, are important factors in the determination of obesity, and like any other bodily phenomenon it is a complex one, varying in different individuals and even in the same individual at different times. Some aspects of these mechanisms are adequately discussed by the author.

There is an excellent chapter dealing with diets for the obese and written by Alice K. Irmisch, dietitian at the Mayo Clinic. It is especially useful because it contains many tables and charts showing how weight loss may be predicted with fair accuracy for a given obese individual on a specific caloric intake.

Rynearson and Gastineau have presented in simple and concise style an excellent review of over 400 papers bearing on this general problem. It should be of especial interest to the physician and teacher of medicine, particularly since it can be read easily in an evening.

DAVID B. TYLER

TUBERCULOSIS. *A Global Study in Social Pathology. By John B. McDougall. Williams & Wilkins Co. Baltimore.* $6.00. viii + 455 pp. 1949.

As a medical adviser to the Section of Tuberculosis of the World Health Organization, the distinguished author of this new British textbook on human tuberculosis has been in an excellent position to procure comparative information about the statistical and epidemiological aspects of clinical tuberculosis on a worldwide basis. It is easy to understand, therefore, why the morbidity and mortality rates for this disease

are viewed by him not only as useful criteria for the entire social structure of a community, but as "the best barometer of any country's progress in civilization, health and welfare." In fact, it is stated in the introduction that "the tubercle bacillus, when implanted in human soil, responds in a sensitive manner to the multitude of varying factors which surround the host in his daily life, whether he be infant, child, adolescent or adult." Although the need for regarding tuberculosis mortality and morbidity as a multifactorial problem is stressed, the author believes that tuberculosis is a preventable disease, if "adequate public health and socio-economic measures are taken to prevent it."

Among the 5 major subdivisions of etiologic factors considered essential in assessing the extent and severity of the tuberculosis problem in various communities, natural or required resistance is listed in addition to the potentiality of infection, the quality of administrative services (real wages), and the adequacy of nutritional and other environmental circumstances (housing, population density, standards of general hygiene, meteorological conditions, dangerous trades). All attempts to single out any one of these causative factors as more important than the others are rejected by the author as less than half-truths, although the significance of genetically determined variations in resistance does not seem to have been given entirely satisfactory consideration. Resistance, whether native or acquired, is assumed to reach its peak in childhood (school age) and to diminish again in adolescence and at different age peaks in adult life in different countries.

The book is clearly organized, richly documented, and written in the superior style of true scholarship. Irrespective of minor idiosyncrasies of the author, it unquestionably ranks with the best dealing with its complex subject.

FRANZ J. KALLMANN

THE CHEMOTHERAPY OF TUBERCULOSIS—THE EXPERIMENTAL APPROACH. *Ann. N. Y. Acad. Sci., Volume 52, Article 5.*

By G. Rake and 35 others. New York Academy of Sciences, New York. $2.50 (paper). Pp. 625–788; ill. 1949.

This compact volume contains a series of 19 research reports presented at a conference held by the Section of Biology of the New York Academy of Sciences on June 24 and 25, 1949. The central theme of the symposium was a comparative analysis of the potential effectiveness of chemotherapeutic agents (sulfones, streptomycin, neomycin, and other antimicrobial agents of bacterial and fungal origin) in experimental tuberculosis. The use of the rabbit, guinea pig, Syrian hamster, mouse and chick embryo in experimental chemotherapy is discussed by one group of research workers, the present state of knowledge about the pharmacological and therapeutic aspects of the various agents by others. According to Lurie, the results of streptomycin therapy, "although eminently successful in certain types of human tuberculosis," have been far short of those anticipated on the basis of studies in animals. In the opinion of Hobson and McDermott, there is urgent need for new criteria by which to evaluate more exactly the effects of antituberculous agents in human tuberculosis. Although the appearance of the sputum of drug-resistant bacilli may serve as a criterion of drug effectiveness in special instances, success in treating miliary and meningeal tuberculosis with a new agent is believed to provide the best evidence of a suppressive effect exercised by the substance on the tubercle bacilli within the human host.

FRANZ J. KALLMANN

AVIATION MEDICINE. *Its Theory and Application.*

By Kenneth G. Bergin. Williams & Wilkins Co., Baltimore. $7.00. xvi + 447 pp.; ill. 1949.

This textbook was written for the medical profession with the intention of presenting a brief review of some phases of the medical, psychological, physiological, and epidemiological problems associated with flying. It can be said that the book is readable, that the subjects are presented in a compact way, and that in those respects the author has attained his aims. However, the volume contains so many errors of fact and so many misleading statements that it cannot be recommended as authoritative for the phases of aviation medicine it covers. For example, the chapters on Diet and Nutrition, Air-sickness, Fatigue and Flying Stress indicate a lack of critical evaluation of data and an ignorance of a great deal of the work done during and since the war.

DAVID B. TYLER

MALARIA: *The Biography of a Killer.*

By Leon J. Warshaw. Rinehart & Co., New York and Toronto. $3.75. x + 348 pp. 1949.

In view of the publicity given it during the recent world conflagration, the fact that malaria is a killer is hardly news, but the account of the blood, sweat, and tears which have gone into uncovering the facts behind the etiology, diagnosis, treatment and control of this disease makes a fascinating story which is well told in this popular book. Not intended as a scientific treatise, this delightful informative presentation of the history of one of man's most deadly plagues nevertheless contains a mass of pertient information useful to the student of parasitology and tropical medicine. The author, apparently not a malariologist, has at times

given undue emphasis to some phases of the story and slighted others which might well have been more fully considered, but all in all the book is well planned and executed.

It is divided into 7 parts which are appropriately named. The first of these, entitled Chills and Fever, traces the general history of the disease down through the centuries throughout the world, and particularly in America. In the opening pages, outlining the scope of the malaria problem and its seriousness, the author somewhat exaggerates the incidence of malaria in this country. At a recent meeting of the American Society of Tropical Medicine, I was surprised, when a show of hands was called for from those who had seen a case of indigenous malaria during the year 1949, that not one hand was raised among over 200 scientists active in the field of tropical medicine. It is difficult to accept, for this reason, the author's statement that there are now an annual average of 4,000,000 cases a year within the United States! That it is still one of the most important diseases in the world today is not to be denied, but the development of control measures and improvements in treatment now available will most certainly go far toward eradicating this disease within our lifetime.

From Miasma to Mosquito, the second part of the book, describes the often blundering progress of man in solving the etiology of malaria. Illuminating chapters in the lives of great names in tropical medicine are presented, and one is allowed to follow the reasoning, right or wrong, of Laveran, Manson, Ross, and Grassi. There is very little of the dull "In 1894 so-and-so discovered that the mosquito was the insect host, etc." tone which often hangs so heavily over scientific histories. The reader almost feels that he is looking over the shoulders of the investigators as they struggle with their fears and doubts in confronting their problems.

Two of the 7 chapters in part 3 deal with field control of malaria in the western hemisphere, and picture the dramatic episodes in the work of Gorgas in controlling malaria in the building of the Panama Canal at the turn of the century, and the courageous fght of Soper and Wilson and their associates in conquering the notorious malaria epidemic in Brazil in the 1930's. Also included are chapters outlining the development of modern mosquito-cidal compounds, including DDT.

Part 4 tells the story of malariacidal drugs up to and including atabrine. An undue amount of space is given to the discussion of the cinchona compounds and their derivatives, but to the lay reader the news-behind-the-news approach to this ignominious chapter in our nation's defense plans will perhaps be interesting. The chapter on The Ideal Drug, although well written, might have been improved by including a consideration of several valuable new drugs already fully tested and on the market when the book went to press.

Malaria in War, part 5, covers the two world wars, but deals chiefly with the more recent combat. Part 6, consisting of only 1 chapter, describes the use of malaria in fever therapy of paresis of tertiary syphilis, as well as the part which drug addiction plays in the epidemiology of malaria. Part 7 is a summary of what the future holds for the malariologist in the form of unsolved problems.

Both as an historical background for the study of malariology, and as a popular scientific summary for the laity, this book should find many interested readers.

ALAN C. PIPKIN

AN INTRODUCTION TO THE STUDY OF EXPERIMENTAL MEDICINE.

By Claude Bernard. Henry Schuman, New York. $3.00. xxiv + 226 pp. 1949.

This new printing of Claude Bernard's classic, first published in 1865, makes available a volume which still has much to say that is of more than historical interest. A commentary on the philosophy of science, written not by a philosopher but by one of the greatest of physiologists, and written *con amore*, it is like a fresh wind blowing through our sometimes too anxious laboratories. The present translation, first published in 1927, has an introduction by L. J. Henderson written at that time, as well as an introductory tribute written in 1878 by Paul Bert shortly after Bernard's death.

Among many interesting comments, Henderson says: "The sciences are not equal, nor do they preserve their rank unchanged as civilization moves on. During nearly a quarter of a millenium mechanics led all the others in intellectual interest and in influence upon European civilization. It will seem to many not too bold a prophecy, for the reasons that Claude Bernard has set forth, to look forward to a century in which physiology shall take a similar place. I venture to believe that that position will be reached when the experimental method has made possible a rational science of organism.

"The physiological researches of Claude Bernard have immortalized his name, but the present work and his other general writings have hardly attracted the attention which they deserve or exerted the influence of which they are capable. This is probably due both to the conflicting influence of bacteriology, organic chemistry, and other sciences and, not less, to his own clearness of vision. That which he saw as the future of physiology remained for many decades hidden from others and so his writings were only half understood. Even general physiology is still hardly aware of the program which he set forth and which it has been unwittingly carrying out. There is, however, one well known instance of his influence exerted farther afield, i.e. . . the naturalism of Zola was suggested by the works of Claude Bernard. . . . The instance is significant of the wide bearing of an interpretation of life which may be seen to be peculiarly well suited to the present

conditions of the political and social as well as the natural sciences."

EVELYN HOWARD

ALLERGY. *Ann. N. Y. Acad. Sci., Vol. 50, Art. 7. By Arthur F. Coca, Max Grolnick, Samuel Karelitz, Arthur P. Locke, Milo G. Meyer, Lester Reddin, Jr., Beatrice Carrier Seegal, Marion B. Sulzberger, and Matthew Walzer. New York Academy of Sciences, New York.* $2.50 (paper). Pp. 679–814; ill. 1949.

This issue of the Annals of the New York Academy of Sciences is devoted to various phases of allergy and of anaphylaxis. Dr. Coca, the consulting editor for the issue, has contributed an article upon the antiallergic action of sympathectomy. He states that this operation supplements the dietary procedure in the food allergic, increasing its effectiveness. Seegal reviews the various anaphylactic phenomena demonstrable in the lower animal and states that the local and systemic effects of hypersensitivity may in man simulate periarteritis nodosa, nephritis and multiple sclerosis. This author also furnishes a chapter upon Allergy of Infection: Relation to Immunity, and stresses the fact that such forms of allergy can be studied properly only in those infections where that antigenic fraction responsible for virulence is known, and when also, it becomes possible to obtain antigenic analyses of bacteria, the quantitative estimate of antibiodies, and the proper analysis of the types of reactions between antigen and antibody.

Reddin, in a discourse upon A Classification of Allergic Diseases and their Specific Manifestations in Animals, reviews the several features of anaphylaxis and of the various clinical forms of allergy in man, and describes the occurrence of such allergic conditions in the lower animal. He is convinced that non-reaginic food allergy occurs in animals although its diagnosis, based primarily upon the change in pulse rate, presents a difficult problem. Karelitz in his article upon Serum Sickness presents interesting data which, he believes, corroborate the idea of von Pirquet and Schick that serum sickness is the result of an antigen-antibody reaction and that the serum sickness antibody and precipitin are not the same. Grolnick furnishes an admirable and comprehensive review of Contact Allergy, while Matthew Walzer discusses Atopic Allergy: Reaginic Sensitivity describing the familial influences, the skin testing techniques, the Prausnitz-Küstner (passive transfer) reaction and methods of treatment. In a brief chapter Sulzberger describes the Immunologic Changes Brought About by Fungi and Fungus Products and recalls Sabaraud's work that showed that each species of fungus had a tendency to produce a particular form of disease. The development of hypersensitivity to fungus allergens is discussed and the characteristics of such sensitivity emphasized.

Meyer contributes an article upon Familial Nonreaginic Food Allergy or "idioblapsis," the name given to this condition by Coca. The author states that migraine, as well as other forms of headache both severe and moderate, physical tiredness, nervousness, indigestion, dizziness, constipation, neuralgia, canker sores, chronic rhinitis, heartburn, and some 22 other forms of symptoms are generally derived from food allergy. The allergenic materials or foods responsible cause an acceleration of the pulse. A careful study of the pulse rate is the only accurate means of identifying the offending substances. Not only foods but other factors influence the pulse, including dust, inhalants (tooth powders, illuminating gas, coal smoke), metal cooking utensils, smoking, cathartics, emotional disturbances. Case reports are given and successful results in treatment listed. As stated by the author, these ideas invite the greatest controversial reaction. The same reaction may be prompted by Locke's article upon Familial Nonreaginic Allergy As a Predisposing Cause of Common Cold. The author believes that in his study the symptoms of a familial nonreaginic food allergy could be found to be associated with a larger number of colds than was observed in the absence of symptoms of such allergy.

This volume contains a considerable stock of ideas upon the allergic condition. Some are stimulating and provocative, some debatable and controversial, and some conservative and generally accepted. It is readily apparent that much effort and study have been expended by the several contributors.

W. C. SPAIN

ALLERGY: *What It Is & What to Do About It. By Harry Swartz. Rutgers University Press, New Brunswick.* $2.75. xiv + 210 pp. 1949.

This handbook was prepared for the public to explain the phenomena of human sensitization, the theories as to its causes and the present concepts of the management of the several clinical varieties of allergy which are listed, and discussed. For any physician who addresses himself to the task of presenting a complicated medical topic in language understandable and interesting to the laity, there is always the temptation to oversimplify, to attract and hold attention by tinging the dull truth with traces of exaggeration or even sensationalism. Swartz, writing in an attractive yet accurate manner, has been successful in avoiding these pitfalls. The early chapters of his volume are devoted to the history of allergy and its theoretical consideration. The mechanisms known to be present in many clinical allergic forms are explained and discussed. Many workers in immunology and in allergy may react violently, however, to Swartz's statements that one person in every two suffers from some allergy and

that the emotional route to allergy is open in every individual.

In the chapters upon the causative factors in allergic conditions, the author lists the generally accepted groups such as airborne substances, foods, drugs, bacterial products. Since this book was written to inform the lay person and to describe the more important preventive measures, it is unfortunate that more stress was not laid on the value of identifying and, where possible, removing infection of the upper respiratory tract, especially in children. Little mention is made of the strategic importance in the asthmatic child of infection in the lymphoid and tonsillar tissue of the nasopharynx which is so often the precursor to paranasal sinusitis of such vital significance in infective asthma.

Concise and excellent descriptions are given of the various clinical forms of allergy such as hay fever, bronchial asthma, the cutaneous, gastrointestinal, neurological and less common forms. While Dr. Swartz presents the theoretical aspects of serum sickness he does not include a discussion of it as a clinical problem, nor does he mention the means whereby it may often be anticipated and prevented. Due to the widespread use of antitoxins which are usually provided in horse serum, there are many families where at least one member has had unpleasant if not dangerous symptoms from spontaneous or acquired sensitization to horse serum.

The volume closes with chapters upon the specific measures employed to prevent allergic symptoms, the methods useful in avoidance of the causes where possible, and various immunization procedures. Lists of useful medications are given but care is taken not to encourage self medication by giving dosages or detailed information. A list is given of the more common allergic factors among airborne substances, foods, drugs, cosmetics, clothing.

This volume will prove most instructive in giving a comprehensive view of the problem of the allergic person. The physician as well as the lay individual may read it with profit.

W. C. SPAIN

CYTOLOGIE SANGUINE. *Normale et Pathologique.* *By M. Bessis. Masson & Cie., Paris.* 1500 fr. (paper). ii + 298 pp. + 19 plates; text ill. 1948. This book is a well organized account of the cytology of blood cells and related tissue cells. Each hemopoietic series is discussed in a chapter of its own. Here both normal and abnormal cytology are discussed, so that normal cytology is scattered throughout the book.

Fundamental questions concerning the origin of cell types and their lineage are discussed at length. All cells considered are interpreted to be derivatives of the reticulo-endothelial system. The undifferentiated stem cell is designated a hemohistioblast. Between this cell and the recognizably specific stem cells such as the myeloblast, proerythroblast, megakaryoblast and lymphoblast lies the hemocytoblast. This cell may be either lymphoid or myeloid, the author believing that its potentiality may be already limited although no morphological clues are present. The monocyte is interpreted to be essentially a blood histiocyte, arising in a series which separates early from the remainder of the blood cell series. The common parent, the hemohistioblast, gives rise to a histioblast, the first recognizable representative of the monocytic series. The histioblast is distinct from the hemocytoblast and possesses "faculté macrophage." It is found wherever reticulo-endothelial tissue is present and may give rise either to the monocyte of the blood or the histiocyte of the tissues. The latter cell, the histiocyte, is credited with multipotentiality, being able to form plasma cells, mast cells and tissue eosinophiles, or even monocytes in the blood. The evidence for this interpretation is drawn from studies of pure hyperplasias (such as infectious monocytosis) which the author believes are *not* dysplasias, the change being wholly quantitative. Previous failure to recognize this developmental series is attributed to the sparseness of these cells anywhere in the body under normal conditions. Considerable objection may be made to the claim that "pure hyperplasias" exist, a critical point since the author's views differ from current ones chiefly on evidence derived from this belief.

Some interesting morphogenetic conceptions are discussed. A nucleocytoplasmic synchronism is described in which the progress of normal nuclear maturation correlates precisely with concurrent cytoplasmic maturation. This synchronism becomes significant in the analysis of certain pathological conditions which are recognizable as upsets in the normal course of maturation. For example, in acute hemolytic anemia, and in certain cases of erythroblastosis, the pathological picture can be recognized to consist essentially of a precocious appearance of certain maturation phases, constituting alteration of the normal synchronism and presenting cell types otherwise difficult to interpret. In acute leukemias there exists what the author calls an "anarchy" of nucleo-cytoplasmic synchronism, where the synchronism as such has been completely destroyed.

The style is, on the whole, clear. The numerous color plates are reasonably faithful for relative hues but the absolute color differs among them. The half tone illustrations, both drawings and photographs, are adequate but undistinguished. Some literature is cited, but this book is not a reference text. There is too much deviation from current opinion for this book to be recommended widely. However, the hematologist or the biologist with hematological background may find it both stimulating and worthy of critical attention.

F. N. LOW

DIRECT ELECTROCARDIOGRAPHY OF THE HUMAN HEART AND INTRATHORACIC ELECTROCARDIOGRAPHY.

By Franz M. Groedel and Paul R. Borchardt. Brooklyn Medical Press, New York. $9.00. vi + 224 pp.; ill. 1948.

This is a discussion of one type of electrocardiogram. It will be of primary interest to those clinicians who wish to compare the results obtained by leading directly off the internal and external surfaces of the heart, with those seen following the more usual (and clinically applicable) electrocardiographic procedures.

R. G. GRENELL

STUDIES IN HYPERTONY AND THE PREVENTION OF DISEASE.

By I. Harris, in cooperation with J. T. Ireland, G. V. James, Edward Cronin Lowe and C. E. Vernon. John Wright & Sons, Bristol; Simpkin Marshall, London; [Williams & Wilkins Co., Baltimore]. $3.00. vi + 114 pp. 1946.

Harris describes here some of his own experiments and clinical observations on the effect of an excess of certain foodstuffs, particularly protein, cholesterol and calcium on blood pressure and circulatory and cardiac diseases.

The author is a strong advocate of the idea of a low calcium intake for people past 40, particularly since some studies show that calcium has a blood pressure raising action. Now, as is well known, the British had very limited allotments of milk during the war. The Medical Research Council, apparently fearing that a calcium deficiency might develop among the population, ordered bread to be fortified with the mineral. This raised the blood pressure of Dr. Harris. In this little monograph Harris presents his side of the battle with the Medical Research Council around what he terms the *Calcium Bread Scandal*. Not having all the facts of the case, it would be wise to take a neutral position but my sympathies are with Harris—on general principles. Anyway, should your library have a copy of this monograph, I can recommend reading the first chapter.

DAVID B. TYLER

PSYCHOLOGY AND ANIMAL BEHAVIOR

METHODS OF PSYCHOLOGY.

Edited by T. G. Andrews. John Wiley & Sons, New York; Chapman & Hall, London. $5.00. xiv + 716 pp.; ill. 1948.

This is a compendium of research methods and techniques in the field of experimental psychology prepared for the undergraduate student. "The material is organized to supplement other textbooks whose purpose is to present the 'content' aspects of psychology."

Twenty-two authors have each contributed a chapter and bibliography covering some area of important experimental research, as follows: An Introduction to Psychological Methodology (T. G. Andrews); Conditioning and Motor Learning (W. N. Kellogg); Studying Memory and Transfer (C. E. Buxton); Studying Human Thinking (E. Heidbreder); Psychophysical Methods (L. L. Thurstone); Studying Perceptual Phenomena (J. J. Gibson); Studying Vision (S. H. Bartley); Studying Hearing (E. G. Wever); Studying the Skin Senses (W. L. Jenkins); Studying the Senses of Taste and Smell (C. Pfaffmann); Studying Proprioception (W. D. Neff); Studying Animal Behavior (H. F. Harlow); Motivation, Feeling, and Emotion (P. T. Young); Methods of Measuring and Recording Action (R. C. Davis); Studying Neuropsychology and Bodily Functions (D. B. Lindsley); Studying Motor Functions and Efficiency (A. G. Bills); Investigating and Appraising Intelligence and Other Aptitudes (H. S. Conrad); Investigating and Appraising Personality (S. Rosenzweig); Methods and Techniques in Clinical Psychology (A. W. Brown); Objective Studies of Disordered Persons (J. Zubin); Methods of Studying the Behavior and Development of Young Children (H. L. Koch); and Studying Social Behavior (T. M. Newcomb).

In reviewing this book one might question, as some reviewers have done, the advisability of separating content and methodology, or one could point up with erudition the unevenness of the various contributed chapters, or question certain inclusions and, omissions or regret the duplications—all these being almost inevitable in a multi-authored work on the subject. However well taken such criticisms might be, they should not serve to obscure or minimize the importance of the book's overall achievement. For in *Methods of Psychology* there is gathered together, and for the first time, the gamut of methods and techniques employed in psychological research with clear presentation and careful appraisal by authors who are themselves qualified experimentalists.

JOSEPH C. FRANKLIN

DIAGRAMS OF THE UNCONSCIOUS. *Handwriting and Personality in Measurement, Experiment and Analysis.*

By Werner Wolff. Grune & Stratton, New York. $8.00. xiv + 423 pp.; ill. 1948.

This is another, and by far the most ambitious, work yet published on handwriting as a diagnostic tool in the study of personality. Wolff believes that personality themes and traits can be discovered through an analysis of handwriting. Despite his arduous efforts to put handwriting analysis on a psychologically sophisticated and objective basis, he is driven again and

again back to clinical assumptions he is loathe to admit into his system of analysis. Nevertheless, the richness and suggestiveness of his treatment of a long disreputable subject in American scientific circles will undoubtedly do much to bring the projective use of handwriting out of the caves of graphologists and into the laboratories of psychologists where, if ever, Wolff's promising leads rather than his performance may sometime establish the valid and reliable use of handwriting analysis in psychological science.

JOSEPH C. FRANKLIN

EVALUATION OF THE MOTHERS' ADVISORY SERVICE. *Monographs of the Society for Research in Child Development. Volume XII, Number 1, Serial Number 44. 1947.*

By Marcia Mann Cooper. Society for Research in Child Development, National Research Council, Washington, D. C. $2.00 (paper). iv + 44 pp. + xxviii pp.; ill. 1948.

This is a report on the success of the Mothers' Advisory Service offered as a special resource in the Child Hygiene Clinic of the Eastern Health District of the Baltimore City Health Department. This service was apparently very helpful in guiding clinic mothers to be more useful and understanding parents. The report demonstrates that an advisory service might well be incorporated in other Child Hygiene Clinics. If this were more widespread, it could only benefit the mental health of children whose mothers could get check-ups for psychic as well as physical health.

HELEN ARTHUR

INTELLIGENCE AND PERSONALITY FACTORS ASSOCIATED WITH POLIOMYELITIS AMONG SCHOOL AGE CHILDREN. *Monographs of the Society for Research in Child Development. Volume XII, Number 2, Serial Number 45. 1947.*

By E. Lakin Phillips, Isabel R. Berman and Harold B. Hanson. Society for Research in Child Development, National Research Council, Washington, D. C. $2.00 (paper). viii + 60 pp. 1948.

In this study of 101 cases of polio in children between 6 and 17 years of age, the authors demonstrate that there is evidence of some decrease in intelligence associated with the disease. It is not known whether this decrease is transitory or permanent. The younger boys in the study seemed to be more affected in this way than any others in the group. There is also reported to be a personality change following polio, but this has not been statistically verified. The monograph points up more problems than it solves.

HELEN ARTHUR

THE PSYCHOLOGY OF ABNORMAL BEHAVIOR. *A Dynamic Approach.*

By Louis P. Thorpe and Barney Katz. Ronald Press Co., New York. $6.00. xvi + 877 pp.; ill. 1948.

This is a comprehensive textbook for the undergraduate student. It is well organized, simply written, and contains a wealth of material on each of the "minor and major personality disorders . . . organized . . . in terms of incidence, symptomology, etiology, treatment, prognosis, and prevention." In addition, the authors have given firm dynamic emphasis to their treatment in "(a) material on the psychogenic background of deviate behavior regarding the home, the school, adolescence, marriage, and other institutions, conditions, and relations; (b) a substantial presentation of the organic psychoses, including the known etiological factors involved; (c) a brief history or perspective of the development of abnormal psychology and psychiatry as related sciences; (d) a chapter on the various psychotherapies used in the treatment of psychoneurotic and psychosomatic disorders; (e) an additional chapter concerned with the psychiatric methods used in the treatment of psychotic and other institutional cases; (f) a presentation of the newer objective and projection tests utilized in the diagnosis and study of a wide variety of behavior disorders; and (g) recent data pertaining to the incidence and treatment of the war neuroses."

The authors' claim that their "point of view is a flexible one which accepts the contributions of more than one school of psychology" is well made, for they "believe that no single system of psychology, no matter how logical its postulates and interpretations may be, can lay claim to the [abundance] of clinical and experimental material upon which a science of abnormal psychology must be founded."

The thoroughness with which the authors have handled their subject, the broad scope of their treatment of it, and their dynamic bias which shows the relationships between aberrant behavior and how it serves functionally as a defense of psychological integrity, all contribute much toward suiting this book excellently to its intended purpose.

JOSEPH C. FRANKLIN

WHAT IS PSYCHOANALYSIS? *New, Revised and Enlarged Edition.*

By Ernest Jones. International Universities Press, New York. $2.00. 126 pp. 1948.

Briefly and in rather bald fashion Freud's apostle in America here introduces the reader to the content and applications of psychoanalysis. In this, one of his last publications before his death, Jones, in his 1947 addendum to the reissue of this work, stated that "although nearly twenty years have elapsed since this book was first drafted I find on rereading it little that needs

changing"—so little did he stray from Freudian orthodoxy! Jones' exposition is unfortunately too general and casual to meet the requirements of either of two distinct groups of readers—those previously unintroduced to psychoanalysis, and those whose introduction to psychoanalysis is behind them. The former will be bewildered and confused, the latter probably bored by this book.

JOSEPH C. FRANKLIN

SOCIAL PSYCHOLOGY. *The Science and the Art of Living Together.*

By Wayland F. Vaughan. Odyssey Press, New York. $5.00. xx + 956 pp.; ill. 1948.

Vaughan has written this textbook because he feels that students need knowledge to apply to the many personal problems that beset them. He says: "... I have selected topics which seem to be of primary concern to the student who is seeking a satisfactory personal orientation amidst the social chaos of our time" (p. vii). Certainly, his book should have provoked high interest. The style is folksy, not difficult, and the student will be untroubled by difficult or complex theories or analyses of problems. Further, many of the more than 900 pages relate anecdotes. Indeed, one feels that journals like the *Saturday Evening Post* and *Harper's Magazine* constitute the major proportion of the bibliographical citations.

Most of the technical and theoretical questions of social psychology are very briefly and sketchily treated. For example, Vaughan quickly describes the theories of Le Bon and of Martin concerning the behavior of crowds, but ignores Freud's theory. His own theory of crowd behavior is that "the crowd situation brings out 'human nature in the raw' by releasing our primitive passions" (p. 260). That is all.

The prevailing tone of the book is liberal. Beyond this and the generally informal air, there seem to be no unifying themes or integrating constructs. The book cannot be recommended as a comprehensive, serious textbook on social psychology, but the chances are good that it will enjoy much favor with students.

CHARLES N. COFER

AN OUTLINE OF SOCIAL PSYCHOLOGY.

By Muzafer Sherif; with an introduction by Gardner Murphy. Harper & Bros., New York. $4.00. xviii + 479 pp. + 4 plates; text ill. 1948.

This is a systematic textbook in social psychology. That is, it represents an attempt to integrate around a central set of concepts some of the major facts of social psychology. Basically, it is a treatment of motivation, or better, of concepts which have been assigned a driving, directing function with respect to behavior. The concepts which Sherif uses are biogenic (tissue) needs and sociogenic (acquired) needs. Since the latter arise through the socialization process they are of peculiar interest to social psychology. Sherif emphasizes the significance of social experience of all kinds in the development of sociogenic needs, and he is critical of any motivational viewpoint which gives sovereignty to the biological drives of early childhood. All behavior occurs within an individual's frames of reference, and the sociogenic factors (such as attitudes, values, ego attitudes, and the like) provide such reference frames, as do, of course, the biogenic drives under conditions of deprivation. Such diverse topics as perception, thought, prejudice, and reactions to social change and crisis are all treated in terms of the frame-of-reference concept.

On the whole, this approach gives coherence to the field, and Sherif's style and provision of numerous experimental and everyday illustrations make for a readable textbook. However, many major topics of social psychology as well as a treatment of its methods have been omitted, and as a textbook this volume will require extensive supplementation, either from the instructor or from outside readings.

CHARLES N. COFER

PSYCHOLOGY: *A First Course in Human Behavior.*

By Edwin R. Guthrie and Allen L. Edwards. Harper & Bros., New York. $3.00. xii + 315 pp.; ill. 1949.

In their preface to this introductory psychology textbook the authors state that they: (1) wished to consider the "new applied fields, ... clinical psychology, industrial psychology, school psychology, the psychology of public opinion," as well as "extensions of psychological theory, particularly into the psychology of personality"; (2) felt it unnecessary to include "the detailed structure of sense organs and nervous systems," as well as other physiological details, in an elementary textbook; (3) wished to write a book devoid of "dried specimens of discarded theories" as well as professional jargon; (4) "have tried also to avoid the too facile eclecticism of some texts," and instead "have made an earnest effort to be systematic..."; and (5) "have tried to emphasize the basis of a scientific psychology in public fact."

The book may well be considered in the light of these objectives.

The usual range of topics in general psychology is covered in this book, from an introductory chapter on scientific method through closing chapters on remembering and thinking. However, except for a chapter on traits and their measurement, there is little that contributes toward fulfillment of the first objective. Even in that chapter such techniques as the Rorschach and Thematic Apperception Tests are discussed some-

what disdainfully, with scarcely a hint of their clinical usefulness. In another chapter on frustration and conflict, the concepts of "role" and "ego" are introduced abruptly, and almost as abruptly dropped, for little use is made of them elsewhere. Nor is this surprising, for neither seems quite congruous with the emphasis placed on simple response learning throughout the text. Statements in the area of psychoanalytic psychology are often oversimplified or incorrect. The following is an example: "Sigmund Freud interpreted behavior as the result of the interplay of two instincts, the life instinct and the death instinct. How much does this tell you of your own future?" (p. 107). That the writers should be unaware of the importance of the ego and the mechanisms of defense in Freud's thinking is surprising in view of their own discussion of these mechanisms elsewhere in the book. To the question they raise one might in turn ask, "Or for that matter, what other theory of behavior, even when fully stated?"

The second objective has been more fully realized. Nonetheless, patches of physiological description remain, the need for which is obscure. For example, in referring to "stage fright" it is said that one of "its components" is "probably a spread of tonus to the visceral muscles. The sphincter muscles which close the entrance to the stomach from the esophagus and the exit to the duodenum may go into spasmodic contraction" (p. 92).

Objective three has been largely achieved, although the writers have a tendency to lean backwards into a talking-to-the-common-people style, of which the following is an example: "A man could duplicate accurately all the movements he had previously used in frying a pancake, shoveling snow, eating a steak, going to the store, but unless the movements end up in a pancake, in the removal of snow, in the presence of the one-time steak in a stomach, in his own presence in the store, the act has not occurred" (p. 66).

As for the fourth objective, an attempt has been made to present a unified theory of behavior, one based on Professor Guthrie's single law of association, deriving from contiguity of cue and response. The names of Tolman and Hull occur but twice in the entire book, while Lewin's is not even mentioned. In view of the wide currency and influence of the views of these three men, it seems legitimate to wonder if the price paid for a systematic treatment in the present case is not too great, especially when the "system" has been raised in monolithic fashion on such a narrow base.

Objective five, placing the emphasis on operational statement, is praiseworthy. Yet, when a simplistic understanding of the nature of operational statement leads to the attribution of reality-value to muscular movements and glandular responses alone, such curious formulations as the following result: "Viewed as a machine, all behavior consists in the operation of muscles and glands. From the noblest oration or the most splendid writing to the ingestion of a piece of buttered toast or the tying of a shoelace, it is muscles and glands that are operating" (p. 67).

This is a textbook that will appeal to students with a naive belief in the simplicity of human experience and behavior.

ERLING ENG

READINGS IN GENERAL PSYCHOLOGY.

Edited by Wayne Dennis. Prentice-Hall, New York. $3.75. xii + 525 pp.; ill. 1949.

By presenting a wide variety of selections from the writings of well-known psychologists, the editor hopes that introductory students will not merely learn "about psychology" but actually "learn psychology." Some 70 different selections written by approximately 55 different psychologists make up the book. These are grouped under the headings: The Sense of Sight, Hearing and Other Senses, Perception, Emotion, Motivation, Learning Behavior, Personality, and Psychological Development. The largest number of pages is allotted to the topics of Emotion, Learning and Retention, and Intelligence, while less than half the same numbers of pages are given to Perception and Psychological Development. Virtually all of the excerpts are from writings of well-known figures in the history of academic psychology. Emphasis, however, has been placed on "basic contributions," with the result that only 6 selections represent the past decade. The final 3 sections, Social Behavior, Personality, and Psychological Development, are perhaps the weakest in the book. These, to be sure, are areas of more recent development, but the selections in these areas scarcely seem to be the most significant or representative ones that could have been chosen. Despite such differences in adequacy of treatment, however, the student of general psychology will have the opportunity, in studying these miniatures of experiment and hypothesis, to observe at first hand the painstaking care with which the psychologist has addressed himself to the task of understanding human experience and behavior.

ERLING ENG

EXPERIMENTAL PSYCHOLOGY. *The Century Psychology Series.*

By Benton J. Underwood. Appleton-Century-Crofts, New York. $4.50. x + 638 pp.; ill. 1949.

In evaluating a new textbook, one is almost inevitably forced to weigh it in relation to the kind of course in which it may be used. This in turn often leads to a consideration of the purpose of the course itself, and of its relationship to the curriculum as a whole. To those who feel that experimental psychology is the core

of any academic program in psychology, the appearance of a new *Experimental Psychology* is the signal for a reassessment of aims and procedures.

It may with some justification be argued that the primary purpose of undergraduate training in psychology, whether "liberal" or predoctoral, is to guide the student toward an appreciation of and a critical feeling for the experimental method, particularly as it is applicable to behavior. This goal can probably never be completely realized in a single formal course, nor can it be achieved in isolation from specific experimental data. It should, indeed, be an active ingredient in every mixture of observation and principle. But in the course labeled "experimental" a most conscious and concentrated effort must be made to impart this working understanding of science. General principles of behavior, it may be assumed, have been described in the introductory course, and special techniques and detailed findings will be presented in later courses. These can, in the second course, be subordinated to the delineation of the theory and practice of experiment.

The proper textbook for such a course, obviously, is not the one which attempts, handbook style, to give encyclopedic coverage of all research in one or several areas of psychology. Neither is it the one which carefully avoids original sources in favor of predigested generalizations. It is rather the one which, selecting a few representative problems, tries to show by illustration how the ideal paradigm of the experimental method has been or might be applied to behavioral phenomena. A beginning can be made in the textual discussion toward the understanding of basic design, control requirements, theoretical interpretation, and operational limitations, and the student encouraged to go to the laboratory and to the library for the continuation of his study.

The perfect answer to the experimental psychology instructor's prayer has not yet been written, but Underwood's book seems to approximate it more closely than do a number of other current candidates. After an excellent introductory chapter on the concepts and methodology of experimental psychology, 4 chapters are devoted to the "discriminal processes." In the tradition of experimental texts, the subtitles of these chapters ought to have been Vision, Audition, The Chemical Senses, and Somethesis. Instead, the chapters bear the secondary headings of Methods of Study I, II and III, and The Influence of General Variables. They are in reality a continuation of the discussion of methodology, increasing in specificity with examples drawn from several receptor fields, as well as from perception and aesthetics. In this way, the student may be expected to maintain his primary orientation toward the problems of experimentation, rather than be diverted unduly to details of the subject matter. Then follow single chapters on motivation, frustration, conflict, transfer of training, Design Methods III and IV, 5 chapters on learning and retention, and a final chapter on work. That the actual literature of experimental psychology is not glossed over is suggested by the 21-page reference section, with 427 entries. An author index and a 16-page glossary and subject index complete the book.

It would be overly optimistic to assume that this is a text without fault. The usage of certain terms (e.g., "lower threshold,") is not always consistent, and there are the typical bibliographical errors (e.g., persistent mis-citing of the Brown conflict study). But the principal basis of final judgment should be the extent to which the goal is realized of guiding the student toward an appreciation of sound experimental design while introducing him to some of the outstanding experimental literature. By this criterion, Underwood has made a valuable contribution to undergraduate instruction.

FRANK W. FINGER

APPLIED EXPERIMENTAL PSYCHOLOGY. *Human Factors in Engineering Design.*

By Alphonse Chapanis, Wendell R. Garner and Clifford T. Morgan. John Wiley & Sons, New York; Chapman & Hall, London. $4.50. xii + 434 pp.; ill. 1949.

This book is one of the first to appear that will help to fill a large gap in the field of applied psychology. Within recent years the tremendous strides made by the field of engineering have produced extremely complicated machinery which often places demands on the human operator that are beyond his physical and psychological abilities. Engineers and designers have needed more precise knowledge of human capacities and limitations in order to hold operating requirements within human capabilities.

Through their work in the fields of the "engineering of machines for human use and engineering of human tasks for operating machines," the authors are able to present here actual studies in the area. Most of the text uses examples and illustrations from recent research. Unfortunately, the authors have had to rely largely on the work of military laboratories or contract research. The area is not completely covered, but this is due to the lack of research rather than to any fault of the authors.

The style of writing and the organization of material is adapted to the worker in the field rather than the academic individual. It is refreshing at times to reed such a style of presentation. The first three chapters give an introduction to the field and include a simple introduction to basic statistics that is essential for proper understanding of the experiments and results.

Treatment of the field of vision includes the fundamentals of vision and their application to instrument dials, legibility, and visual displays. After a discussion of the basis of hearing, the available information

is applied to the communication problems of speech and signalling systems. Human problems of response and movement are presented first in respect to types of movements and then in combination with the field of perception, under the heading of machine controls. Types of controls are discussed in respect to errors of response, realism, recognition, control forces, and aiding ratios. The general areas of working environment and fatigue include work arrangements, fatigue, work curves, sleep, and the effects of environmental factors of atmosphere, motion, noise, and illumination.

In addition to an excellent discussion of the field, the compilation of numerous charts and tables and a very extensive bibliography is of great value. Much of the visual material is new, well presented, and of real value to people in this field of both applied and basic research. It is to be hoped that additional research in the areas of perception, habit, training, and attention will be done in the near future to help close the omissions evident in this book.

R. Y. WALKER

HUMAN PERSONALITY AND ITS MINOR DISORDERS. *By William Harrowes. Williams & Wilkins Co., Baltimore (made and printed in Great Britain).* $3.50. vii + 260 pp. 1949.

In this volume the author, formerly Assistant Psychiatrist at the Henry Phipps Psychiatric Clinic and now Medical Director of a private psychiatric hospital near Edinburgh, gives an extended statement of the Meyerian principles. It is in effect an amplification of the courses in psychobiology and psychiatry taught at the Phipps Clinic during Dr. Meyer's long reign, and contains little of his more recent work, which mght well be integrated into the Meyerian framework.

In the final chapter on treatment, my estimate is that the author concedes too little to the development of insight and too much to measures which might be lumped together as self-disciplinary curative items. It may be admitted that certain patients do well with such a regime, and the author's experience probably justifies such a formulation. Others of us who were trained under Meyer are inclined to place more stress on the development of insight and understanding, leaving to the patient's spontaneity those items which in the author's formulation are not so casually treated. All one can say about this difference is that they represent methods not incompatible with the overall psychological formulation.

WENDELL MUNCIE

ADOLESCENT FANTASY. *An Investigation of the Picture-Story Method of Personality Study. By Percival M. Symonds. Columbia University Press, New York.* $6.00. xii + 397 pp. + 42 plates; text ill. 1949.

This impressive study was made to determine the usefulness of a projective test in understanding the adolescent character. The author and his coworkers developed a series of 42 pictures, especially designed to appeal to the adolescent mind. These were presented to 40 normal teen-age boys and girls of Suburban City who elaborated stories about them. The stories elicited from these youngsters were carefully analyzed for the various themes or emotional trends they indicated. These themes were compared with a wide range of factual data on each subject to ascertain what, if any, significance this fantasy material had in revealing the adolescent character. From this exceedingly careful and detailed approach, the author has been able to state a number of conclusions not only about the projective test but about adolescents in general. Throughout the book there is a nice balance between the statistical use of the data and a reporting of the actual clinical material. Two full case records are included, one of a maladjusted boy and one of a well-adjusted boy, to illustrate the author's methods even more graphically and to lend dramatic emphasis to the study.

HELEN ARTHUR

THE DYNAMICS OF PARENT-CHILD RELATIONSHIPS. *By Percival M. Symonds. Bureau of Publications Teachers College, Columbia University, New York.* $3.50. xviii + 197 pp. 1949.

The importance of this very interesting survey of parental attitudes and how they affect children's personality development is defined by the author's thesis that "personality is largely a product of the interactions between parents and child." The original attitude, of course, is that expressed by the parent and so the source of personality lies in this area.

After stating his position in this regard, Symonds describes a number of aberrant parental feelings, how they may develop within the parent, what response they elicit from the child, and how the youngster's personality is affected by this fundamental interpersonal experience. He takes up parental rejection, parental overindulgence, parental overdependence, parental ambivalence, parental overprotection, parental overauthority, and how combinations of any of these may exist in the same parent. Then in the next to last chapter the Essentials of Good Parent-Child Relations are discussed, with emphasis on the maturity of the parent, his capacity for identification with the child, and his ability to have a sound marital relationship. Throughout all this material, Symonds is careful to point out unconscious factors which operate in the development either of wholesome or unwholesome attitudes toward children. Since the book was written for "counselors and psychotherapists who work in child

guidance" and associated fields, there is a final chapter that relates the preceding material to its usefulness in psychotherapy and in parent education.

Symonds has done a good job. He has presented lucidly, in unpretentious English, a psychodynamically oriented study of the way parents are reacting. He has done it in a systematic, scholarly fashion that is not only convincing but also illuminating. It should be a helpful book to anyone who is professionally interested in personality work with children—or to any parent who can afford to overhaul his own attitudes in the interest of his child's personality.

HELEN ARTHUR

PERSONNEL SELECTION. *Test and Measurement Techniques.*

By Robert L. Thorndike. John Wiley & Sons, New York; Chapman & Hall, London. $4.00. viii + 358 pp. 1949.

The recent technical advances which promise to convert the field of personnel selection into a scientific practice rather than a subjective one are well brought together here. The exposition on the use of measurement techniques in the selection of personnel for specific types of work merits the attention of all psychologists and personnel workers interested in this field. Although the book deals with the highly scientific aspects of measuring individual aptitudes and personality attributes, the style in which the facts are presented is unusually clear and easy to follow. Few books in the complex field of psychological measurement approximate this clarity of presentation.

The book encompasses the various technical considerations involved when the psychologist attempts to apply a scientific approach to the problem of fitting men into jobs. The first step in this process, the author states, is an analysis of the various duties necessary for successfully performing a given job. Next comes the difficult process of securing objective tests which will measure a man's aptitude for performing these same duties; or to state the problem negatively, the process of selecting tests which will screen out those persons unfit for the successful performance of specific kinds of work. The bulk of the text is devoted to technical and statistical considerations regarding the measurements to be used to accomplish the purpose of relating personal aptitudes to the traits needed for proficiently performing specific jobs. First, in addition to the usually discussed statistical factors related to the problem of making objective measurements "reliable" (self-consistent), Thorndike presents an interesting and comprehensive analysis of the types of error which interfere with achieving reliability of a set of test scores. He then proceeds to the next and most important aspect of measuring aptitudes, namely, the matter of the "validity" of the measurement. Validity in this connection simply means the degree to which the objective measurements can accurately predict subsequent success on the job. Thorndike states that the most difficult part of the problem of predicting measurement is that of obtaining satisfactory criteria against which to validate the selection procedures, although without such measures the whole research program is thwarted. He then presents in considerable detail the difficulties which the research worker who attempts to secure adequate criterion measures must overcome. He elaborates the statistical procedures used on criterion measures in order to apply them to the task of predicting job success from the test scores.

Since a given type of job usually calls for several different types of aptitudes, such as a certain degree of intelligence, certain skills, a certain degree of interest, etc., Thorndike discusses the statistical methods which may be used to combine test scores into some meaningful and valid form for predicting success in the job. He evaluates the methods of combining test scores in a statistical fashion, with the evaluative functions needed when tests which measure single functions alone are used. Finally, he takes up some practical and administrative issues involved in a testing program and attempts to place the responsibility of the psychologist in it. While this book is not written for the layman, inasmuch as it frequently makes use of the somewhat involved statistical formulas of the science of measurement, it stresses primarily the reasoning behind those formulas so that its concepts are clearly defined. It is one of the few excellent textbooks so far published in this field.

MARION R. BARTLETT

DIFFERENTIAL PSYCHOLOGY. *Individual and Group Differences in Behavior. Second Edition.*

By Anne Anastasi and John P. Foley, Jr. Macmillan Co., New York. $5.50. xvi + 894 pp.; ill. 1949.

This is a revision of Anastasi's *Differential Psychology* (*Q. R. B.*, 13: 380), published in 1937. The objectives remain essentially the same—to present differential psychology as "one approach to the understanding of behavior," to coordinate the various topics loosely included in this field, and to present the major findings of differential psychology in a form "readily comprehensible to the college student." It is still a textbook rather than a handbook, and emphasis is less upon exhaustive coverage than upon guiding the undergraduate toward the development of skills of critical objective evaluation. The major concepts underlying the problems of individual and group differences are stressed more than specific data, and methodological problems of investigation more than definitive conclusions.

Reflecting a healthy growth in the body of research

during the 12 years, the present book is approximately 65% larger, with its bibliography more than doubled. There have been added chapters on Basic Concepts of Psychological Testing, Biological and Psychological Factors in Simple Behavior Development, and Schooling and Intelligence. Some sections remain unchanged, but many are reworked and extended, particularly to include a greater number of longitudinal studies and material on personality differences. It is clear from this comprehensive treatment that the problems of differential psychology are now clearly enough formulated that the investigations of the next few years can be even more fruitful than those of the past decade.

FRANK W. FINGER

PROPHETS OF DECEIT. *A Study of the Techniques of the American Agitator. Studies in Prejudice. Sponsored by The American Jewish Committee. Social Studies Series: Publication No. I.*

By Leo Lowenthal and Norbert Guterman. Harper & Bros., New York. $2.50. xx + 164 pp. 1949.

DYNAMICS OF PREJUDICE. *A Psychological and Sociological Study of Veterans. Studies in Prejudice. Sponsored by The American Jewish Committee. Social Studies Series: Publication No. IV.*

By Bruno Bettelheim and Morris Janowitz. Harper & Bros., New York. $3.50. xxii + 227 pp. 1950.

These are among the first volumes in a series of Studies in Prejudice sponsored by the Research Department of the American Jewish Committee. The assistance of anthropologists, psychologists, sociologists, and other social scientists was secured by the committee for a comprehensive and systematic investigation of the causes of racial prejudice and of its effects on community life.

The first volume, *Prophets of Deceit*, analyzes the speeches and writings of some dozen contemporary American demagogues, such as Father Coughlin and Gerald L. K. Smith. Using many direct quotations, the authors have extracted what is common to all these agitators, such as cataloguing of grievances, presenting "the people" as helpless dupes of evil powers, showing the agitator as one called upon to save them, and offering various minority groups as scapegoats. The analysis is penetrating and complete. Few, if any, of the demagogue's tricks for winning popular allegiance or for channeling hostility into intergroup hatreds escape the powerful searchlight turned upon every nook and corner of their murky realm. The agitators presented in this volume apparently do not have any concrete plans for human betterment. They offer only scapegoats as outlets for grievances, and vague promises that the agitator will lead them into promised lands. The authors leave one with the impression that this is true of all demagogues. Yet one has only to think of Huey Long to realize that demagogues sometimes include specific positive objectives in their programs, such as super-highways, stadiums, or old age pensions. One wishes that the documents on which the book is based—or at least an adequate sampling of them—could have been included in an appendix. The critical reader would like to test for himself the analysis made in the text.

The second volume, *Dynamics of Prejudice*, describes the personality characteristics and general life circumstances which accompany prejudiced attitudes toward Jews and Negroes. This description is based on lengthy interviews by social workers with a sample of 150 veterans in the Chicago area. Adequate techniques were used to make this a truly representative sample, and the interviews seem to have been conducted in such a manner as to gain, on the whole, truthful and complete answers. The questionnaire used by the interviewers was cleverly designed to get not only the respondent's interracial, but also many other possibly related attitudes. He was searchingly questioned, once rapport had been gained, about his attitudes toward his home, his war experiences, his job, the government, and so on. Unfavorable attitudes toward the Jews were not found to be associated with income, religion, education, or the actual severity of war experiences. Such attitudes were significantly related, however, to a deterioration in economic circumstances (downward mobility) and to attitudes toward war experiences. The prejudiced veterans were more likely to feel that they had not had a fair deal in the army and to be embittered about army life. The prejudiced veteran is pictured as having had an insecure childhood, and as being on the downgrade economically, anxious about the future, mistrustful of the government and other institutions, and resentful toward his superiors in the army. Hostility toward the Jews seemed to be associated with much pent-up hostility in many aspects of life. The prejudiced individual felt aggrieved and carried a chip on his shoulder. In his estimation, life had not treated him well or fairly. There were many exceptions, of course, to this picture. Sometimes a veteran who seemed to have most of the characteristics of a prejudiced person was nevertheless tolerant. The authors analyze such cases carefully. Maybe such an individual had other outlets for his hostility, or kept it under control through a well developed conscience or out of respect for the generally tolerant attitudes prevailing in his community. Intolerance toward the Negro was, on the whole, related to intolerance toward the Jews. Prejudice toward the former, however, was more universal and more freely expressed. It seemed less controlled by social pressures. Whereas less than a third advocated restrictive measures against the Jews, two-thirds did so against the Negroes.

In planning their research and in interpreting its results, the authors used a psychoanalytic orientation. This was both a strength and a weakness—a strength, in that it led them to probe deeply and to uncover

complex mechanisms; a weakness, in that it led them to overlook other approaches to their material and to assume psychoanalytic complexities possibly not inherent in their data. A veteran who thought that Negroes were dirty, immoral, and irresponsible, and should be kept in their place, may not necessarily have been projecting his own desires to be dirty, immoral, and irresponsible onto the Negro and fighting them conveniently there rather than in himself. He might simply be parroting what he had heard during his formative years from people he respected and thus enjoying the feeling of superiority those ideas gave him. The authors' oft repeated statement that "intolerance is always an outlet for hostility" (p. 163) seems extreme and not to follow necessarily from the data. All in all, *Dynamics of Prejudice* presents a penetrating analysis of the needs satisfied by intolerant attitudes and of some of the circumstances which give rise to such attitudes.

CLARENCE LEUBA

REHEARSAL FOR DESTRUCTION. *A Study of Political Anti-Semitism in Imperial Germany. Studies in Prejudice. Sponsored by The American Jewish Committee. Social Studies Series: Publication No. II.*

By Paul W. Massing. Harper & Bros., New York. $4.00. xx + 341 pp. 1949.

This historical study of pre-Nazi anti-Semitism in Germany is another of the new Studies in Prejudice series. The author, a sociologist, traces political anti-Semitism from the time of Bismarck to the outbreak of the first World War. His research shows that German anti-Semitism, coupled with antiliberalism, developed after the depression of 1873 on the part of Catholics, Prussian conservatives, and the lower middle class (Mittelstand). This early anti-Semitism was political and economic rather than religious or racial.

A few years later it took on a more racial character. Massing comments on this period as follows:

> The analysis of German anti-Semitic literature, movements, and agitators discloses some rather unexpected and puzzling facts. The most implacable enemies of the Jews were urban rather than rural; indifferent, if not hostile, to the church rather than devout Christians, and members of the "educated" rather than the "ignorant" classes. The most virulent kind of anti-Semitism was spread throughout Germany by teachers, students, industrial and commercial employees, petty officials, professional people, and followers of cults of every variety: members of "life reform movements", whole-rye bread dietitians, opponents of vivisection, and "back to nature" builders of body and soul. From these groups, not from the peasants or the land-owning aristocracy or the reactionary clergy, narrow-minded though they might have been, came the fanatical haters of Jews.

He sums up the early years in these words:

> The years 1875–1895 were the formative period of all German political anti-Semitism. In the economic transformations and political conflicts of these twenty years anti-Semitism was established as a quasi-automatic group reaction as well as a consciously used instrument of power. The conditions of its growth and its inherent explosive forces had become discernible a generation prior to the Nazi ascent to power.

While German imperialism waxed under Kaiser Wilhelm II, however, political anti-Semitism waned. Domestic liberalism was less of a threat to a regime whose main energy was devoted to competing with Britain, France, and other world powers. But a nucleus of "intellectuals" carried on the cult of anti-Semitism and nurtured it until the days of Adolf Hitler.

Massing's scholarship is impressive, and he buttresses it with well over 100 pages of notes and documents for reference. His research shows clearly that anti-Semitism in imperial Germany was primarily a technique or tool used by powerful groups to manipulate the middle class and thus gain political and economic advantage. Such highlighting of the role of leadership and propaganda, of the ebb and flow of political and economic changes, is a helpful supplement to the psychiatric emphasis found in other volumes of the Studies in Prejudice series.

S. STANSFELD SARGENT

THE AUTHORITARIAN PERSONALITY. *Studies in Prejudice. Sponsored by The American Jewish Committee. Social Studies Series: Publication No. III.*

By T. W. Adorno, Else Frenkel-Brunswik, Daniel J. Levinson, and R. Nevitt Sanford, in collaboration with Betty Aron, Maria Hertz Levinson, and William Morrow. Harper & Bros., New York. $7.50. xxxiv + 990 pp. 1950.

Those who seek to lay bare the roots of prejudice usually focus upon either cultural and social forces or upon the personality dynamics of individuals. Contributions in both these major directions are made by the five recent Studies in Prejudice sponsored by the American Jewish Committee, under the general editorship of Max Horkheimer and Samuel H. Flowerman. Three of the volumes are psychologically oriented; in the words of the editors they attempt answers to the question: "What is there in the psychology of the individual that renders him 'prejudiced' or 'unprejudiced" that makes him more or less likely to respond favorably to the agitation of a Goebbels or a Gerald K. Smith? The volume on *The Authoritarian Personality* . . ., based upon a combination of research techniques, suggests one answer. It demonstrates that there is a close correlation between a number of deep-rooted personality traits, and overt prejudice."

The authors began by administering questionnaires to over 2000 college and non-college adults. These included scales on anti-Semitism, ethnocentrism, politico-economic ideology, and a "fascism" scale to

disclose antidemocratic trends. Eighty persons who scored extremely high or extremely low (principally on the ethnocentric scale) were subjected to intensive interviews to learn what a subject "thinks about himself, about his hopes, fears and goals, about his childhood and his parents, about members of the other sex, and about people in general." Most of the same subjects were also given the Thematic Apperception Test and asked a number of "projective" questions, such as "What great people, living or dead, do you admire most?" and "If you knew you had only six months to live, but could do just as you pleased during that period, how would you spend your time?"

Using a modified Freudian type of interpretation, the authors find that several personality types or syndromes characterize the high and low scorers, i.e., those most and those least prejudiced. Some prejudiced persons are notable for surface resentment; for them the Jews serve as a kind of scapegoat, to relieve them of feelings of failure and guilt. Others are conventional and fear to be different, while a few may be classified as rebels or psychopaths. But it is the "authoritarian" syndrome which comes closest to the "overall picture of the high scorer as it stands out throughout our study." This is a sadomasochistic pattern by which the subject adjusts himself through obedience and subordination while his sadistic tendencies work themselves out in agressiveness against outgroups.

The problem of modifying potentially fascist personality structure, the authors conclude, is comparable to eliminating neurosis, delinquency, or nationalism from the world. Social reforms alone are not sufficient to change the structure of the prejudiced personality. "For the fascist potential to change, or even to be held in check, there must be an increase in people's capacity to see themselves and to be themselves. This cannot be achieved by the manipulation of people, however well grounded in modern psychology the devices of manipulation might be. . . . It is safe to assume, however, that fascism is imposed on the people, that it actually goes against their basic interests, and that when they can be made fully aware of themselves and their situation they are capable of behaving realistically." The authors' chief hope is placed in improved techniques for psychotherapy which can be adapted for use with groups and even on a mass scale.

Some psychologists and social scientists will find that *The Authoritarian Personality* relies too heavily upon psychoanalytic interpretations. The authors, however, are not unaware of the impact of social and cultural determinants, though they do not emphasize them. Theirs is a collaborative effort to disclose the personality dynamics of prejudice, and they deserve great credit for carrying through the most extensive and thorough study yet undertaken.

S. STANSFELD SARGENT

ANTI-SEMITISM AND EMOTIONAL DISORDER. *A Psychoanalytic Interpretation. Studies in Prejudice. Sponsored by The American Jewish Committee. Social Studies Series: Publication No. V.*

By Nathan W. Ackerman and Marie Jahoda. Harper & Bros., New York. $2.50. xvi + 135 pp. 1950.

This volume of the new Studies in Prejudice series sponsored by the American Jewish Committee is concerned, like *The Authoritarian Personality*, with the dynamic sources of anti-Semitism. Ackerman and Jahoda, however, have chosen a specialized group of subjects—severa dozen emotionally disturbed anti-Semitic persons who have undergone psychoanalytic treatment. Their material was derived from lengthy interviews with analysts (27 cases) and with psychiatric social workers attached to social agencies (13 cases).

The authors find that "anti-Semitism is *not* the concomitant of any one clinical category of personality disturbance. . . . Anti-Semitic reactions are found in psychoneurotics of various types; in character disorders, perhaps more particularly of the sado-masochistic type; in psychopathic and psychotic personalities as well as in others with less precisely defined disturbances." Their cases manifest pervasive anxiety, hostility, a confused self-image, shallow personal and group relationships, strong conformist and compensatory tendencies, and the like. Study of personal development reveals a fairly typical psychological atmosphere: bad marital relationships on the part of parents, rejection, inconsistent and strict discipline, and repressed aggression. Oedipal conflict also appeared—distortion and difficulty in the process of identifying with parents, though its relation to later anti-Semitism seemed indirect. Anti-Semitism was found to serve several mechanisms by which the patient deals with his conflicts, viz., projection, denial (repression), displacement, reaction formation, introjection, and substitution of aggression for anxiety.

Ackerman and Jahoda are well aware of the part played by social pressures as well as by intrapsychic factors, particularly with reference to the nature of the Jewish stereotype and to the actual manifestation of anti-Semitic attitudes. "The evidence," they note, "points against any one-sided attempt to explain anti-Semitism exclusively as a psychological phenomenon. Social and psychological determinants are inseparable, often indistinguishable, components in the production of the phenomenon of anti-Semitism."

Rounding out their interpretation, the authors devote a final chapter to the context of anti-Semitism in America: the competitiveness, acquisitiveness, need for companionship, and increasing secularization, for example. These are powerful trends, but the authors comment that opposite forces are at work, too, as would be shown by psychodynamic study of the unprejudiced person.

The authors have not proved that anti-Semitism *results* from emotional disorder, as they well realize.

Many of their cases were less anti-Semitic than many persons not undergoing psychoanalytic treatment. But Ackerman and Jahoda have pioneered in exploring relationships between anti-Semitism and other variables in individuals whose case studies were available. Their findings are of interest in themselves, and their methods should lead to further productive research.

S. STANSFELD SARGENT

SOCIAL PSYCHOLOGY OF MODERN LIFE. *Second Edition.*

By Stewart Henderson Britt. Rinehart & Co., New York. $4.50. xvi + 703 pp.; ill. 1949.

Dr. Britt's first edition enjoyed a high degree of popularity as a textbook, and the features which made it popular have been retained in the present edition which otherwise shows evidence of considerable change and rewriting. The style is simple and the illustrations, anecdotes, and humorous remarks make for interesting reading. Britt does not perplex the student with theoretical or methodological complexities, and the treatment is largely topical, i. e., each topic is considered more or less separately from the others. Britt hopes that the book will enable the student "to give meaningful answers to many practical questions of everyday life" (p. 3). He observes that social psychology today is empirical, objective, and healthily skeptical, and presumably he wishes to develop these attitudes in his readers.

Most of the topics and problems ordinarily "assigned" to social psychology are covered in this volume, although methods and theories are very inadequately treated. One feels that the student will have a good time while reading this book, that he may gain some assistance in his thinking about social problems, but that social psychology will remain for him a hodge podge of interesting and loosely related items. If he has had a good course in general psychology, he will wonder, among other things, where the four important aspects of conditioning (p. 99) came from. They illustrate the "flexibility" of concepts as Dr. Britt uses them, for the four aspects of conditioning which he stresses (generalization, differentiation, traumatic experience, and ready-made acceptance of "ways") are not found in this form in standard works on the subject.

This is not the book for a theoretical and methodological analysis of the problems of social psychology. But these ends Dr. Britt did not design his book to serve.

CHARLES N. COFER

THE HARVARD LIST OF BOOKS IN PSYCHOLOGY.

Compiled and annotated by the psychologists in Harvard University. Editor: Edwin G. Boring. Harvard University Press, Cambridge, Mass. $0.00 (paper). vi + 77 pp. 1949.

This list of 612 important books in psychology was prepared as a cooperative undertaking by 20 members of the instructing staffs of the Department of Psychology and the Department of Social Relations in Harvard University. Each item is accompanied by a short, frank appraisal of its significance. The entries are grouped under 31 headings which thoroughly cover the range of contemporary, scientific psychology. The list should be useful to undergraduate and graduate students in psychology, to professional psychologists, and to intelligent laymen who want to know about authoritative books on selected topics in psychology. The total list also provides a faithful picture of the scope of present-day psychology and so should be useful as a checklist for small psychological libraries.

A. CHAPANIS

SELECTIVE PARTIAL ABLATION OF THE FRONTAL CORTEX. *A Correlative Study of its Effects on Human Psychotic Subjects.*

By The Columbia-Greystone Associates. Editor: Fred A. Mettler. Paul B. Hoeber, New York. $10.00. xiv + 517 pp. + 36 plates; text ill. 1949.

This is an account of one of the most ambitious projects of its kind ever attempted. The kind of study reported here has been made inevitable by the widespread use of damage to the central nervous system of humans for therapeutic purposes. This joint project, undertaken by the department of neurology of the College of Physicians and Surgeons, Columbia University and the New Jersey State Hospital at Greystone Park, grew out of the use of surgical techniques in the treatment of behavioral disorders. The project is definitely experimental in approach, however. It represents a careful and elaborate treatment by a tremendously large number of scientists of a group of patients for the purpose of obtaining information about the effects of partial ablation of the frontal cortex. Twenty-four subjects (patients) were used as controls and twenty-four others were subjected to a variety of frontal ablations, called "topectomies." In the operated subjects, the eleven Brodmann areas rostral to area four were systematically removed in various combinations, according to a pre-arranged experimental scheme. The operations were designed so that, insofar as possible, artifacts were avoided, and information could be obtained about each important area involved.

The data are summarized in the form of information concerning anatomy, physiology, psychology and psychiatry. In addition, many individual contributors report the results of particular tests or techniques, such as word-association tests, audiometric findings, electro-

encephalography, learning and retention, etc. In all, forty-three individuals are listed as having contributed something to the final writing of the report. In addition a large number of technicians and scientists contributed to the study in one way or another.

The results of exhaustive study reported in this volume are almost entirely negative in character. Of the various physiological functions studied, none were affected by the operations with the possible exception of convulsions. On specific psychological tests there were very few detectable changes in the patients following operation. A few temporary and isolated changes were suspected, though these did not reveal any consistent or meaningful pattern. Nor was it possible to establish any definite conclusions concerning the therapeutic value of the types of operations used compared with those already in use.

The predominance of negative conclusions is apt to lead one to be slightly disappointed. However, it is important to realize that we are still in a very primitive state of knowledge concerning the functions of the human frontal lobes. This study has the function of pointing out that there is no existing theory of the function of frontal areas in human beings which seems capable of standing up against new data. Landis, in his summary chapter on psychology, admits that the study has nothing positive to add in the way of a new formulation which would replace the older ones. The authors of this study are to be commended on their conservatism in this respect. Too many times, elaborate theory has been based on far more tenuous evidence than that presented here.

One gets the impression that the book could have been much shorter, particularly the sections dealing with the results of various tests administered to the subjects. Each investigator included a vast amount of protocol-material, in the manner of extended clinical studies. The material is over-interpreted. This is particularly true where indications of positive change were found. It would not be difficult to believe that the few instances of positive changes represented simple random sampling. "Nine times out of ten neither the average or variability of the operated group differed significantly from that of the control group" (p. 306). This is just about what one would expect by chance alone. A study in any area where the facts exist in greater abundance would surely have ignored the scattering of positive results found in the psychological and physiological areas. The psychiatric sections, of course, are almost entirely clinical, and it is only possible to evaluate them in this light.

It is to be hoped that this pioneering effort in the concerted experimental and clinical attack on the functions of the human cortex will be followed by others. Succeeding studies should be able to profit from the mistakes of this study as well as the mine of information it supplies.

JAMES DEESE

COLOURS AND HOW WE SEE THEM.

By H. Hartridge. G. Bell & Sons, London. 15s. net. xii + 158 pp. + 15 plates; text ill. 1949.

This little book contains the substance of a series of six Royal Institution Christmas Lectures given by the author in 1946–1947. The Christmas Lectures have produced some excellent books of popular science because, by tradition, famous scientists come out of their laboratories to tell interested young people about their own specialties. This volume should rank with the best of them.

Color is an inherently interesting topic to most people and Professor Hartridge's treatment of the subject is fascinating. He first describes the properties of the electromagnetic spectrum and then, in the second lecture, shows how colors are produced in the laboratory and in more familiar objects like soap bubbles, mother-of-pearl, rainbows, and sunsets. The third lecture tells how colors are used in science, the arts, medicine and everyday life. Lecture four is concerned with the eye as a color-sensing organ, and the last two lectures deal with illusions of color, and some colors with strange properties. The lectures were accompanied by a number of ingenious demonstrations which have provided the author with a set of fine illustrations—many of them colored.

This is an elementary treatment of color suited for the general reader in science. Even so, the more sophisticated reader should find much here to excite his interest because Hartridge has written about commonplace and unusual phenomena in a thoroughly enjoyable manner.

A. CHAPANIS

AUFGABE DER PSYCHOLOGIE. *Eine Geschichte ihrer Probleme.*

By Paul v. Schiller. Springer Verlag, Wien. $4.00 (paper). iv + 233 pp. 1948.

The author presents a critical survey of the main psychological concepts from Plato and Aristotle to Gestalt psychology and field theory. He wants to show that psychology is actually destined to become a science of the origin, the course and the effect of human action.

"Action is the totality into which enter all movements, perceptions, thoughts, conditions and strivings . . . it is the only actual psychic reality which gives to each factor its meaning. Unconscious stimulations are the prime movers, inner experience is the steersman, and movements are the executives of action . . . Action is "behavior" which is dependent on the actual situation and capable of changing this situation."

There are forces which bring about action: need (Beduerfnis) and stimulation (Aufforderung). Need is a biological want (originating within the organism) which endows the steering external factors with the "signs" of stimulation (Aufforderungszeichen). The

objective biological and social situations and demands obtain—in correlation with needs—a significance towards removal of biological wants. As needs have a biological representative, so stimulations have an historical one. Their objective origin lies outside of the organism, which however determines the action.

The process which furnishes the power to change the situation with the help of behavior is called urge (Antrieb). The formulations of action and urge lead to a theory of motivation. Action—(or perhaps "operation" is a better term for the German "Handlung")—is a highly organized biological process which arises from the meeting of physiological and historical circumstances in their relative significance. It is capable of changing the constellation of these factors and their field of forces. The analysis of operation is concerned with the hanging together and the structure of those factors which constitute action. The reconstruction of these relations within the totality is called motivation. The essential task of psychology is to investigate motivation.

WALTER O. JAHRREISS

CORPUS COMMENTARIORUM AVERROIS IN ARISTOTELEM. *Vol. VII—Parva Naturalia.*

By Aemilia Ledyard Shields. Mediaeval Academy of America, Cambridge, Mass. $10.00; $8.00 to members of the Academy. xxxiv + 276 pp. 1949.

"Parva naturalia" is the name of eight short treatises, dealing with physiological and psychological questions, by Aristotle. Five of these, viz., On Sense and Sensible Objects, On Memory and Recollection, On Sleep and Waking, On Dreams, On Prophecy in Sleep, and On Length and Shortness of Life, were epitomized by the Arabic physician and philosopher Ibn Rushd of Cordoba, who completed the work in Sevilla in 1170. Like other works of Averroes (the latinized form of his name), these compendia aroused great interest among western medieval scholars, and a Latin translation appeared in two versions. One version, probably by Michael Scot, is extant in a large number (more than 60) of manuscripts, whereas the other version is preserved only in the Cod. lat. 16222 of the Bibliothèque Nationale in Paris. Both versions are critically edited in the present book accompanied by indices which give the probable Arabic and Hebrew (Index I) as well as Greek (Index II) expressions for the Latin terms, and the references to Aristotelian and a few other writings quoted in the Latin versions.

The interest of these compendia lies chiefly in the fact that they are not mere epitomes. Averroes summarized the Aristotelian text from his own point of view, incorporating much that reflects his own philosophical concepts or those current at his time. Regarding the latter, the passages dealing with divination and prophecies, for instance, are quite remarkable, since they throw light on Neoplatonic as well as popular trends in Christian-Islamic thought. Of course, the striking differences between the two Latin versions open the question as to possible interpolations by the Latin translators, a question hardly to be decided in the absence of Arabic originals.

The work has been done with care and sagacity and the external appearance of the book is equally satisfactory.

OWSEI TEMKIN

PSYCHOLOGY IN EVERYDAY LIVING.

By Ralph Leslie Johns. Harper & Bros., New York. $3.50. xii + 564 pp.; ill. 1950.

Designed for the first college course in psychology, this new textbook emphasizes the applications of psychology in everyday living. The principal means employed by the author, a consulting psychologist as well as a teacher, to realize this objective is an abundance of abbreviated case histories and anecdotal materials. These are used to illustrate various concepts and principles advanced in the book.

The author's viewpoint is broadly eclectic and, in accordance with his practical approach, he includes somewhat less physiological detail than is customary in the usual textbook. At the same time, the treatment of the various standard topics is simplified and is relatively free of theoretical discussion. Included in the book is a variety of aids for learning and teaching: a basic vocabulary before each chapter, questions for discussion, easy experiments, brief self-examinations at the ends of chapters, as well as references to films that have been found useful in presentation of the course. For an introductory textbook, this one has considerable appeal to the eye. Pictures and diagrams have been generously provided, and the chapters are clearly outlined. Very legible typeface and plentiful space between lines make for rapid, comfortable reading. It is likely that *Psychology in Everyday Living* will find its greatest reception in basic psychology courses offered for the one-course student of the subject.

ERLING ENG

NEW WAYS IN DISCIPLINE. *You and Your Child Today. By Dorothy Walter Baruch. Whittlesey House, McGraw-Hill Book Co., New York, London, and Toronto.* $3.00. xvi + 280 pp.; ill. 1949.

At last a book has come out presenting an enlightened approach to the problem of disciplining children! Dorothy Baruch's central thesis is that parents should pay attention to their children. By "attention" she

means more than just a casual ear cocked for the small fry's demands or a perfunctory period put in playing games with the children. She indicates energetically but good-humoredly that parents must learn to "stop, look, and listen"—take time, in other words, to watch what their children tell them in action and to listen for the real meaning behind their verbalizations. Baruch does not advocate indulgence as an alternative to old-fashioned discipline. She urges rather that children be taught control through understanding of their feelings and by methods that will enhance the relationship between child and parent. Her concrete suggestions are practical and clear. If a child expresses a negative feeling in action, it will be a relief to that child if the parent can put the feeling into words for him. The youngster will know that he is understood even if the action employed cannot be condoned. Baruch points out that repression (particularly through fear) of "badness" in a child is only a second-rate solution. The "badness" must be understood and then channelized into constructive efforts.

In order to enlarge parents' vision, Baruch takes up some specific situations around which there may be points of conflict in any household and presents the child's point of view about them. Next, in Part 3, she gives definite directives about how parents can work, as she puts it "in times of peace to reduce times of stress"; in other words, how to cement the basic relationship with your child which is the only foundation for real discipline.

The author has a very friendly, cheerful way of developing her material. She has wisely chosen a few simple but very important points and has elaborated these from a variety of angles so that every parent can grasp the essential truth of what she has to say. She has absorbed the feeling of sound psychiatric principles without even getting close to using psychiatric shop-talk. In terms of a useful contribution in the area of improving parent-child relationships *New Ways in Discipline* is a major work.

HELEN ARTHUR

HUMAN BIOLOGY

TECHNIQUES OF CONCEPTION CONTROL. *A Practical Manual Issued by the Planned Parenthood Federation of America. Third Edition.*

By Robert Latou Dickinson. The Williams & Wilkins Co., Baltimore. 50 cents (paper). 59 pp.; ill. 1950.

This manual is as informative and up to date as could be wished. The chief addition to the new edition is a brief discussion of Effectiveness and Acceptability, by Christopher Tietze. From published data he has tabulated the comparative effectiveness of different methods in terms of conceptions per 100 years of exposure. From this it appears that the variation in effectiveness of a single method is as large as the difference in effectiveness between methods, and depends upon the levels of training and education in the groups compared.

THE COMMUNITY OF MAN.

By Hugh Miller. Macmillan Co., New York. $3.00. vi + 169 pp. 1949.

The author, professor of philosophy at the University of California at Los Angeles, rather sharply defines our present day dilemma: "Philosophy does not and cannot answer our most ultimate question." "Four centuries of modern science have deprived man of all moral and religious faith." But Miller is fortunately solving our dilemma with a new science of his own making, "evolutionary science." He unveils a rather grandiose picture, first of biological evolution, then of the evolution of matter. In his notion of evolution looms large the concept of surviving groups, replacing the notion of species. His organic science is a "moral science" too. The "good" is the well adapted, is whatever insures numerical increase. All this makes, like Spengler, rather stimulating reading, though in my modest opinion it has absolutely nothing to do with science. It is good old philosophy which need not count in reality, as long as it is logical. The late Hegel's devilish tail hangs out of the overalls of our modern anti-philosophical philosopher.

The pitiful inadequacy of the philosopher to contribute seriously to our problems becomes obvious when the author derives in the last fourth of his volume from his grandiloquent structures a master plan for our own social future. The thing is deceptively simple. All that is, is, of course, reasonable as a product of evolution. Therefore the tragic duality of communist and individualist economics was "contained in the very bowels of nature," and must always coexist. It was "written" in the same bowels that natural evolution should issue two "complementary types" of political economy. Because complementary they are: both Christian, both democratic, both progressive! Therefore all that is needed is mutual respect beween the U. S. A. and Soviet Russia. Amen.

ERWIN H. ACKERKNECHT

THE CRIME PROBLEM. *Appleton-Century-Crofts Sociology Series.*

By Walter C. Reckless. Edited by John F. Cuber. Appleton-Century-Crofts, New York. $4.25. xiv + 537 pp.; ill. 1950.

At most, criminology is an intellectual and scientific waste-heap. If one rummages around in it long enough,

he will be able to recognize the scraps and tag-ends of every known discipline and field of knowledge. There is no curriculum that does not contribute to it; in one or another of its aspects and subdivisions every science and study have a part. Like many another, Reckless has taken it upon himself to bring order out of the chaos of the study of crime. The critical standards by which the success of such an Augean task is adjudged have to be scaled accordingly. Reckless is no Hercules, but he deserves a high mark for effort. *The Crime Problem* has as its stated purpose to bring together "town" and "gown" between the covers of a book which will serve the interests of each and seal the rift which has been chronic between those who work in institutions and those who talk about them from the secure vantage point of the academic rostrum. A purpose like this is undeniably noble. The question is: How well does it succeed?

In my opinion it succeeds not at all. For all the work of Reckless, it can be predicted that the "town" and "gown" will continue to war. And this, I believe, is because Reckless is confused as to exactly who and what the "town" is. For Reckless, as for every other individual writing about crime and delinquency, the "town" comprises the bright young men and women, fresh from the "gown" or at least aligned with it by background or personal history or individual striving. These mediate between the delinquent and society, mostly in terms and through the mechanics of paper. They are the midzonal group, the middle echelon in society's concern with the offender. But they are not the important cogs in the wheel, as Reckless and his fellow-workers in the delinquency vineyard seem to believe. Of course, they are the easiest to write to and to address in Institutes, Congresses, and Annual Meetings: indeed, they are the only ones available to listen. Who ever heard of a prison guard, an ordinary key-swinger on a tier, a hack at the grille, a turnkey, or a gun-toting square on the cat-walk going to the fancy ballrooms of smart hotels where Conventions are held at state expense? And yet—who really represents Society to the inmate? Who is in almost constant contact with him?

There is little fault to find with Reckless' book. It is the competent job of a competent individual, commendably dull in the correct places to satisfy the "gown," enlivened here and there to bespeak the continued interest throughout its 500-odd pages of the "town." It is sprinkled with case records, illustrated with a few antiseptic photographs at which we can point with pride, and has two pictures supposed to invoke exclamations of shame and the determination to "do something about it." Readers of this journal will not find the book of special interest to them, apart from the fact that it does provide general information about a field with which their responsibility as citizens requires them to know something.

ROBERT LINDNER

TWILIGHT IN INDIA.

By Gervée Baronte. Philosophical Library, New York. $3.75. xx + 382 pp. + 11 plates. 1949.

Mrs. Baronte had a lot of trouble with domestic help in India. She didn't like the whole set-up anyway: the unashamed acceptance of the fact of sex, the castes, the religion of the people, their superstitutions, and so on. The outcome is this highly subjective and emotional book. It obviously never occurred to her that the Indians might not like her either or her crowd and their superstitions, and could write an equally nasty book about them. The book is completely worthless from a scientific point of view.

ERWIN H. ACKERKNECHT

MAN THE TOOL-MAKER.

By Kenneth P. Oakley. British Museum (Natural History), London. 2s. 6d. (paper). vi + 98 pp. + 2 plates + 1 chart; text ill. 1949.

This is one of the very competent guide books the Department of Geology of the British Museum has published in recent years. This particular volume gives the basic data on what is called archeology in this country, prehistory in Europe. Describing the technology of early man, it is a companion volume to W. E. Le Gros Clark's well known volume on the anatomy of early man, published in the same series. Like Le Gros Clark's book that of Dr. Oakley can be profitably used as a textbook. It condenses all the essential data of European as well as African and Asiatic prehistory on 98 pages and is well illustrated.

ERWIN H. ACKERKNECHT

POPULATION TRENDS AND POLICIES. *A Study in Australian and World Demography.*

By W. D. Borrie. Australasian Publishing Co., Sydney. 21s. xxii + 263 pp.; ill. 1948.

The purpose of this little book, as stated in the preface, is to provide a basis for the discussion of Australian population questions, especially to analyze the economic and social consequences of fertility and immigration trends and to assess their significance in the formulation of policy. It is emphasized that the secular transition from the large family of the Victorian age to the small family of today is not a phenomenon peculiar to Australia, but that the pattern of controlled fertility has been or is being established in all countries inhabited by peoples of European background. Australia cannot expect to reach a population of twenty million, considered desirable from the point of view of national security, by the excess of births over deaths, regardless

of what pronatalist policies are adopted. Nor can she count on heavy immigration from Britain to continue for an indefinite period. The author concludes that a realistic population policy compatible with democratic values and practices can only aim at the ultimate establishment of a stationary, self-replacing population and that Australia should seek immigrants from Eastern Europe, a type of immigration that hitherto has not been encouraged. He feels that unlimited admission of Asians would not offer any real relief to the overpopulated countries adjoining Australia, but he urges some revision of the "White Australia" policy to reduce international tensions. The ultimate solution of Asia's population problem—of vital importance to Australia—will rest on technological development, both agricultural and industrial. "This will assist the dissemination of new ideas, and lay the foundation for advances in education and the spread of birth-control habits." Australian delegates to international bodies are urged to support measures serving these objectives.

CHRISTOPHER TIETZE

THE PREHISTORY OF SOUTHERN RHODESIA. *An Account of the Progress of Research from 1900 to 1946. Natl. Mus. S. Rhodesia, Museum Memoir No. 2.*

By Neville Jones. Cambridge University Press, Cambridge. $2.00. 78 pp.; ill. 1949.

During the last 50 years it has become increasingly clear that the African soil harbours archeological evidence of great age and importance. Mr. Jones, as the keeper of the Department of Prehistory of the National Museum of Southern Rhodesia, has been connected for many years with archeological efforts in Southern Rhodesia, and gives here a convenient summary of archeological results so far obtained in that region. He reviews in particular the findings on river terraces, in caves, and the famous rock paintings. Though Southern Rhodesia has so far not yielded findings of as sensational a nature as some other South African sites, the material is of considerable interest. The honesty with which Mr. Jones reports and corrects his own past errors is particularly priceworthy.

ERWIN H. ACKERKNECHT

SURFACE SURVEY OF THE VIRÚ VALLEY, PERU. *Volume 43: Part 1—Anthropological Papers of The American Museum of Natural History.*

By James Alfred Ford and Gordon R. Willey. The American Museum of Natural History, New York. $1.50 (paper). 89 pp.; ill.; 7 plates. 1949.

The area selected for this archeological investigation was chosen because it had been occupied for a long period of time and was rich in shards. The object of the investigation was to assemble a large quantity of material, and then to classify and date it. All told, 315 sites were visited, from one of which over 2,000 artifacts were taken, and from another only 5. The size of the samples taken from other sites ranged between these extremes. Seven very fine photographic plates depict sample specimens of these artifacts. The result of the investigation was that it was found possible to arrange these artifacts in chronological sequence, but was quite impossible to assign even approximate dates to them. Five folded charts inserted in the book illustrate the history and the prehistory of the valley, but no attempt has been made to correlate the culture of this valley with that of any other region. The only attempt at chronological date fixing is a statement that the history of man in the Virú Valley is included within the past 4000 years. For this reason the work as a whole is likely to appeal only to those who are specialists in the field of American archeology. It is a highly technical piece of research.

THE MAYA CHONTAL INDIANS OF ACALAN-TIXCHEL. *A Contribution to the History and Ethnography of the Yucatan Peninsula. Carnegie Institution of Washington Publication 560.*

By France V. Scholes and Ralph L. Roys; with the assistance of Eleanor B. Adams and Robert S. Chamberlain. Carnegie Institution of Washington, Washington, D. C. $4.75 (cloth); $3.50 (paper). xii + 565 pp. + 4 maps + 17 plates. 1948.

The occasion for this publication was the recent discovery in the Archives of the Indies at Seville of a document in the Chontal language recounting the expedition of Cortés from Mexico to Guatemala, with the circumstances leading up to it. Documents in Chontal are extremely rare, and this is the only one known which deals with this period in Middle American history. It is a translation from a still older document in Nahuatlac, which presumably is no longer in existence.

A surprising point brought out by the explanatory chapters is that one reason why an insignificant handful of adventurers such as the followers of Cortés were able to subjugate a nation which had through the centuries achieved a relatively high degree of civilization was that the natives had no innate resistance to the diseases which the Spaniards introduced among them—smallpox, tuberculosis, measles, and perhaps the most debilitating of all, malaria and syphilis. At the same time, the natives seem to have been a peculiarly healthy people, with no diseases at all that they could communicate to the invaders. The Spaniards did not know it, but they were engaging in bacterial warfare, without which it is not impossible that their invasion of Mexico might have been a failure.

The facsimile reproduction of the original Chontal narrative occupies 15 pages, the Spanish and English

translations 38 more, the bibliography 14, and an extremely complete index 38. The remaining 475 pages are devoted to historical research, and constitute an interesting and valuable compendium of data scholarly assembled.

BIOMETRY

MATHEMATIK FÜR NATURWISSENSCHAFTLER UND CHEMIKER. *Eine Einführung in die Anwendungen der höheren Matematik.*

By Hugo Sirk. [*Theodor Steinkopff, Dresden und Leipzig*]; *J. W. Edwards, Ann Arbor.* $4.50. xii + 282 pp.; ill. [1942] 1945.

STATISTICS. *An Intermediate Text Book. Volume I.*

By N. L. Johnson and H. Tetley. Cambridge University Press, New York (printed in Great Britain). $4.00. xii + 294 pp. 1949.

In using the subtitle, *An Intermediate Text Book*, the authors mean to indicate that the development in this book requires considerable mathematical sophistication on the part of the student—more than one could reasonably expect from students in the biological sciences. Actually the text was prepared for actuarial students and there is little in this book to recommend it over a number of other statistics texts which are more suited to the needs of biologists.

This should not be taken to mean that the book is without merit, for as such books go, this is a good one. The first four chapters are concerned with descriptive statistics and they discuss the conventional measures of central tendency, dispersion, and correlation. The next four chapters develop, at a theoretical level, concepts of statistical inference and important probability distributions. The final two chapters are essentially practical, putting to use the principles discussed earlier for the solution of experimental problems. There are four appendices dealing with Sheppard's correction for grouping, Stirling's approximation for n!, the normal curve as an approximation to the binomial, and a table giving values of the ordinate and the cumulative distribution function for the normal curve.

A. CHAPANIS

DE OMNIBUS REBUS ET QUIBUSDAM ALIIS

AUDIO-VISUAL AIDS TO INSTRUCTION. *New Second Edition.*

By Harry C. McKown and Alvin B. Roberts. McGraw-Hill Book Co., New York. $4.50. xvi + 608 pp.; ill. 1949.

An analysis, brought up to date, of the uses of models and specimens, of globes and maps, of charts and posters, still and motion pictures, prints, slides and the role of experience in making many of these, in teaching at grade school and high school levels. The value of trips and tours, and ways to arrange them, round out the subject. Each chapter ends with a carefully selected list of references to books and magazine articles in popular and technical journals. There is a good index.

LORUS J. & MARGERY J. MILNE

QUANTITATIVE ULTRAMICROANALYSIS.

By Paul L. Kirk. John Wiley & Sons, New York; Chapman & Hall, London. $5.00. viii + 310 pp.; ill. 1950.

For those who may still be confused as to what is meant by ultramicromethods, it should be pointed out that it is now generally agreed that macromethods are employed when the sample size is of the order of 100 mg. or more; semi-micromethods are employed for samples varying from 10 to 20 mg. or the equivalent; micromethods involve sample sizes of the order of 1 mg.; and ultramicroanalyses are employed for the determination of amounts of the order of 0.001 mg. (1 μg.). A more convenient term probably would be "milligram analysis" for sample sizes of 1 mg. or so, and "microgram analysis" for sample sizes of the order of 1 μg. This volume summarizes the present status of ultramicroanalyses that have proved useful and practical, and includes many tested colorimetric procedures that to date have met the standards of accurate analytical requirements.

The 10 chapters include a rather extensive discussion of volumetric and colorimetric apparatus and technique, general apparatus and technique, microgram titrimetry, titrimetry methods for metallic and non-metallic constituents, volumetric gas methods, spectrophotometric methods, and physical methods. All sections and most procedures are amply illustrated with either original or well selected drawings and charts.

This volume will be of especial value to those in the fields of biochemistry, medicine, and other biological disciplines where the requirements demand the use of very small scale methods. Unquestionably, every biochemical laboratory should have this volume at hand.

DAVID B. TYLER

THE QUARTERLY REVIEW OF BIOLOGY publishes critical reviews of recent researches in all of the special fields of biological science. The contribution should present a synthesis or digest of the researches and a critical evaluation of them. A mere synopsis of the literature without evaluation or synthesis is not desirable.

Theoretical papers are published occasionally, especially when such papers (1) include a critical synthesis of the literature bearing on the theory and (2) are likely to promote further research in a given field.

The article should be written in concise language, yet in sufficiently non-technical form as to be intelligible not only to specialists in other fields but to the general biologist as well. To this end the article should have a general introduction and a summary which enumerates one by one all of the principal facts and conclusions given in the paper. Interpretative diagrams and schemes are very desirable.

Material ordinarily taking the form of footnotes is set in small print and placed in the text and consequently should be written in a style so as to fit readily into the text. Acknowledgments are printed in the text in small type at the end of the article just preceding the List of Literature. Recent issues of the Quarterly should be examined for style as regards (1) section or subsection headings in the text, (2) literature citations in the text, and (3) List of Literature.

The subjects and authors of articles are selected by the Editors and members of the Advisory Board. Unsolicited articles which conform with the objectives of the Quarterly will be considered for publication.

A feature of the REVIEW is the section dealing with *New Biological Books*. In this department the book literature of different countries in the field of Biology is given prompt notice.

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